REFERENCES

1 Central Bureau of Statistics, Population Projections for Kenya 1980 - 2000, March 1983.

2 Central Bureau of Statistics, The Integrated Rural Survey 1976-79 Basic Report, February1982.

3 JSCE, Suiri Koshiki Shu, in Japanese,1985.

4 Lake Biwa Research Institute, Data Book of World Lakes, 1984.

5 LBDA, A Socio-Cultural Investigation in the Use and Functioning of the Completed Shallow Wells in Nyanza Province Main Report, 1983.

6 LBDA, Effluent Monitoring and Pollution Control Fieldwork, August1985.

7 LBDA, Lake Basin River Catchment Development -- River Profile Studies C.Lotti & Associates, October 1985.

8 LBDA, Lake Basin-Rural Domestic Water Supply and Sanitation Program, Water Resources Survey and Survey Training Program; Water Resources Survey, Volumes I-X, 1984,1985,1986,1987.

9 LBDA, Lake Basin Shallow Wells Pilot Project, 1982.

10 LBDA, Nyando Flood Protection Project, November 1986.

11 LBDA, Sondu River Multipurpose Development Project, JICA, 1985.

12 LBDA, The Rural Domestic Water Supply and Sanitation Programme Work Plan 1985, Work Plan 1986, Work Plan 1987, 1985, 1986, 1987.

13 LBDA, Water Management in the Lake Basin Development Authority Area by D.A. Okun in the Technical Annex to the Final Report on the Current and Future Implications of Development to the Aquatic Environment of Lake Victoria, Edited by P.M. Olindo, March 1985.

14 LBDA, Webuye Rongai Hydroelectric Scheme Project Identification Report, Konstanz and Darmstadt, June 1984.

15 LBDA, Winam Gulf Baseline Study Summary Report on Activities , July 1984 to August 1985.

16 LBDA, Workshop on the Quality of Water Input to Lake Victoria A Workshop Report, Edited by C.O Okidi and P.M. Olindo, August 1982.

17 Mahamud, M.M., Country Report for the group training course in water works engineering in Japan, April 1986.

18 Major, D., Applied Water Resources Systems , Prentice-Hall, U.S.A, 1979.

19 Ministry of Agriculture, Yala Integrated Development Plan , 1982.

20 Ministry of Energy, Small Scale Hydro-electric Schemes in South- West Kenya: II Feasibility Study Report for Teremi Falls,1982.

21 Ministry of Local Government, Eldoret Water Supply Phase II, Mangat, I.B. Patel and Partners, April, 1984.

22 Ministry of Local Government, Kitale Water Supply Preliminary Design Report, Sir Alexander Gibbs and Partners, December 1977.

23 Ministry of Local Government, Kisumu Water Supply and Sanitation Study Feasibility Study, H.P. Gauf Vol.1, November 1985.

24 Ministry of Finance and Planning, District Development Plan 1984/1988.

25 Ministry of Water Development, Bungoma Rural Water Supply Preliminary Design Report, Haward Humphreys Ltd., July 1982.

26 Ministry of Water Development, Design Manual for Water Supply in Kenya.

27 Ministry of Water Development, Kericho Water Supply Scheme Final Design Report, H.P. Guff, October 1983.

28 Ministry of Water Development, Limnological Investigation of lakes in Kenya 1976-1977, Technical Report No.6, January1978.

29 Ministry of Water Development, Lower Nzoia River Flood Protection, 1976.

30 Ministry of Water Development, Migori - Kihancha Water Supply Project Preliminary Design, Kigoni and Partners, July 1983.

31 Ministry of Water Development, National Master Water Plan, THAMS, September1980.

32 Ministry of Water Development, Pre-investment Study for Water Management and Development of the Nyando and Nzoia River Basin, Italconsult, October 1983.

33 Ministry of Water Development, Rural Water Supply Development Project in Western Province of Kenya Development Plan Main Report, KEFINCO, June,1983.

34 Ministry of Water Development, Rural Water Supply Development Project in Western Province of Kenya Progress Report April - September, KEFINCO, 1985.

35 Ministry of Water Development, Rural Water Supply - Nyanza & Western Provinces, Preliminary Hydrogeological Investigation, Ker, Priestman & Associates, January1980.

36 Ministry of Water Development, Siaya Water Supply Project Revised Preliminary Design Report, Otieno Odongo and Partners, November 1982.

37 Ministry of Water Development, The Water Chemistry of the Nzoia River,1973-1975, Technical paper No. 4, 1976.

38 Ministry of Water Development, The Water Chemistry of the Nyando River 1974-75, Technical paper No.1, 1976.

39 Ministry of Works, Extension of Kenya Nile Basin Water Resources Survey, Sir Alexander Gibb. & Partners, 1961.

40 Ministry of Works, Kenya Nile Basin Water Resources Survey, Sir Alexander Gibb. & Partners, 1954 and 1956.

41 Chabeda, P.I.M., A Survey of Eutrophication and Water Pollution Load's in Four Rivers of the Northern half of the Lake Basin Development Authority, March 1983.

42 Republic of Kenya, Development Estimates for Year 1986/87, and volumes of previous years.

43 Republic of Kenya, Development Plan 1984-1988.

44 UNEP, State of the Lake Victoria Basin Aquatic Environment: Water Quality and Sources of Water Pollution, A.G. Tumbo-ocri, October 1982.

45 University of Nairobi, Natural Resources and the Development of Lake Victoria Basin of Kenya, Edited by C.O. Okidi, International Law and the Lake Victoria and Nile Basin by C O Okidi, July 1979.

46 University of Nairobi, Natural Resources and the Development of Lake Victoria Basin of Kenya, Edited by C. O. Okidi, The Quality of Water of the Lake Victoria Basin and its Protection by B.S. Meadows, July 1979.

47 WHO, Rapid Assessment of Sources of Air, Water, and Land Pollution, 1982.

48 Ministry of Water Development, Nyanza Province Annual Report 1984, August, 1985.

49 Ministry of Water Development, Western Province Annual Report 1984, May 1984.

50 Ministry of Agriculture and Livestock Development, Master Development Plan for PIU Western Province Engineering Sector Report, Probi and Italeco, May 1986

51 LBDA, Background Paper Prepared for Interministerial Committee on Flood Control on Nyando River Basin, May 1985.

52 Kite, G.W., Recent Changes in Level of Lake Victoria, Hydrological Sciences - Bulletin, 1981.

53 Grundy, F., Rainfall and River Discharge in Kenya during the Floods of 1961-1962.

54 Kerio Valley Development Authority, Regional Development Plan for the Kerio Valley Basin: Water Resources Study, Sogreah, February 1982.

55 DHV, The use of Remote Sensing and Geophysics for Groundwater Exploration in Nyanza Province - Kenya, February 1987.

56 Thomas, K.C., Nandi Forest Multipurpose Reservoir Project, paper for the seminar held on 10th February 1987 by LBDA and JICA.

57 LBDA, Lake Basin River Catchment Development -- Catchment conservation and Rehabilitation: Report on Phase 1, April, 1986.

58 University of Nairobi, Soil and Water Conservation in Kenya, 1983.

Table 7.1 Major Rivers in the Lake Basin

River	Catchment area km^2	Length km	Average Gradient(1/1000)	Annual Rainfall, mm/yr
Sio	1,364	83	3.4	1,680
Nzoia	12,696	252	4.0	1,350
Yala	3,262	212	6.8	1,500
Nyando	3,450	142	9.5	1,400
Sondu	3,489	157	9.9	1,480
Kuja/Migori	6,868	208/185	4.2/4.3	1,340
Mara	8,470	231	6.1	980

Notes: (1) First and second figures in the Kuja/Migori correspond to the length and average gradient of Kuja and Migori rivers, respectively.
(2) The Mara river flows down to Tanzania and finally drains into Lake Victoria. The catchment area shown above is the one in the Kenyan territory.

Source: Catchment area is taken from Lake Basin River Catchment Development River Profile Study and the others are measured by Study Team.

Table 7.2 Daily Evaporation Rate

(unit: mm/day)

Station	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	
Ahero Exp. St.	5.6	6.3	6.0	5.3	4.8	4.7	4.5	4.8	5.1	5.2	5.2	5.2	El. 1,219 m (1959-83)
	7.2	7.8	6.9	5.9	5.5	5.7	5.6	5.7	6.3	6.5	6.2	6.3	(1959-70)
Kisumu Airport	7.6	7.8	7.3	6.4	6	5.9	5.6	5.8	6.7	6.9	6.7	6.8	El. 1,157 m (1958-70)
Sotic W. Supply	4.2	4.3	4.0	3.7	3.5	3.3	3.0	3.4	3.6	3.7	3.4	3.8	El. 1,950m (1965-81)
Kericho T.R.I.	4.9	4.7	4.6	3.5	3.4	3.5	3.2	3.3	3.8	3.6	3.4	4.0	El. 2,134 m (1963-70)

Source: JICA, Sondu River Multipurpose Development Project

Table 7.3 Major Stream Gauges and Average Annual Rainfall and Runoff

Stream Gauge	River Basin	Catchment Area (km^2)	Average Annual Rainfall (mm)	Average Annual Runoff (m^3/sec)	Recorded Period
1AH1	Sio	1,450	1,750	10.5	1970 to date
1BD2	Nzoia	3,825	1,110	16.4	1966 to 1977
1CE1	Kipkaren (Nzoia)	24,440	1,170	15.6	1949 to date
1DA2	Nzoia	8,417	1,180	45.9	1947 to date
1EE1	Nzoia	11,849	1,360	82.7	1947 to date
1FE1	Yala	1,896	1,570	21.3	1961 to 1974
1FG1	Yala	2,388	1,600	27.7	1947 to date
1GD1/3/4	Nyando	2,600	1,420	15.5	1949 to date
1JG1	Sondu	3,260	1,480	41.6	1947 to date
1KB1A	Kuja	3,115	1,500	34.9	1951 to date
1KC3	Migori	3,046	1,240	17.7	1951 to date
1KB5	Kuja/Migori	6,600	1,350	53.2	1951 to date
1LA3	Mara	679	1,360	10.4	1964 to date

Source : Computed by Study Team.

Table 7.4 Monthly Flow Record at Major Gauge Stations (1/13)

STATION NAME	: 1AH1	RIVER SYSTEM	: SIO RIVER
STATION ID NUMBER	: 10181	NAME OF RIVER	: SIO RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: WESTERN
CATCHMENT AREA	: 1450.0 (SQ.KM)		
PERIOD FOR APPLIED	: 11 (YEARS)	FIRST YEAR	: 1970

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1970	7.6	6.3	11.2	44.0	40.0	20.9	10.5	13.5	21.4	17.4	12.5	6.7
1971	5.2	3.6	3.5	5.7	24.1	17.6	9.9	9.9	14.7	16.2	10.8	9.2
1972	7.8	8.7	4.0	6.3	30.4	27.7	17.1	13.6	11.8	22.6	41.3	26.8
1973	9.4	8.8	4.1	7.9	19.8	21.4	7.0	7.6	15.5	10.0	15.1	4.5
1974	3.3	2.3	2.6	16.5	28.3	10.4	10.7	6.9	7.4	6.9	3.9	2.2
1975	1.6	1.5	2.0	16.5	22.4	20.4	6.4	9.7	8.4	11.5	5.0	2.4
1976	1.7	1.5	1.5	2.7	7.9	14.0	13.5	8.0	8.0	4.3	3.6	2.9
1977	1.7	1.6	1.4	15.2	34.5	24.2	8.7	7.2	3.6	7.4	25.7	6.9
1978	3.4	2.8	14.2	20.6	40.7	14.3	8.1	6.0	5.4	5.6	6.3	2.5
1979	1.7	7.8	5.9	14.3	32.9	27.3	8.5	3.7	1.9	1.4	1.2	1.1
1980	0.7	0.4	0.5	5.3	13.6	4.2	2.6	2.6	1.2	0.8	2.4	1.0

Source: Hydrology Section of Ministry of Water Development

Table 7.4 Monthly Flow Record at Major Gauge Stations (2/13)

STATION NAME	: 1BD2	RIVER SYSTEM	: NZOIA RIVER
STATION ID NUMBER	: 10242	NAME OF RIVER	: NZOIA RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: WESTERN
CATCHMENT AREA	: 3825.0 (SQ.KM)		
PERIOD FOR APPLIED	: 12 (YEARS)	FIRST YEAR	: 1966

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1966	3.0	3.3	4.2	14.5	10.4	7.0	14.5	22.8	33.1	12.3	12.8	5.6
1967	3.6	2.8	2.7	5.9	40.8	19.3	68.2	84.6	30.2	24.5	27.7	18.5
1968	8.0	8.9	15.2	13.8	27.3	17.5	16.9	63.1	14.5	11.2	12.1	13.2
1969	6.7	7.5	7.7	5.3	13.4	7.3	10.8	18.5	23.7	9.4	9.0	5.6
1970	6.0	5.1	5.6	9.9	13.9	12.5	18.7	83.4	47.0	19.9	13.0	7.7
1971	6.1	4.1	3.6	7.0	13.6	18.4	28.5	36.8	44.7	24.5	13.4	9.1
1972	6.8	6.5	5.2	4.3	8.7	9.4	22.5	23.5	13.0	12.5	20.3	8.6
1973	5.8	4.0	3.4	2.7	5.4	8.4	8.2	21.6	18.9	9.7	10.5	4.8
1974	3.2	2.1	2.8	4.3	5.1	7.1	17.4	19.6	21.0	10.5	5.9	3.5
1975	2.4	1.8	2.1	4.5	8.7	12.7	30.7	122.2	72.6	30.4	13.4	8.0
1976	5.4	4.1	3.2	4.9	12.3	11.5	20.2	20.5	21.7	7.8	5.7	6.7
1977	4.8	3.5	3.0	26.1	71.2	22.9	29.8	87.7	24.8	28.4	67.8	29.1

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (3/13)

STATION NAME	: 1CB1	RIVER SYSTEM	: NZOIA RIVER
STATION ID NUMBER	: 10351	NAME OF RIVER	: KIPKAREN RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: WESTERN
CATCHMENT AREA	: 2440.0 (SQ.KM)		
PERIOD FOR APPLIED	: 33 (YEARS)	FIRST YEAR	: 1949

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1949	3.7	2.2	1.5	2.5	5.2	13.3	14.4	32.5	39.4	15.8	7.6	5.3
1950	3.1	1.6	2.0	3.5	2.6	5.1	18.1	45.8	32.5	15.6	6.5	3.8
1951	2.3	1.6	1.6	16.7	18.7	21.7	19.4	68.1	24.8	23.6	20.1	42.3
1952	17.8	8.4	5.0	16.3	88.4	15.0	37.1	58.2	41.9	27.1	12.9	6.9
1953	3.7	2.0	1.8	2.4	3.6	3.9	4.7	9.5	3.3	2.2	1.3	1.5
1954	1.4	0.7	0.5	1.8	7.6	8.6	15.3	35.8	39.5	11.3	4.0	3.8
1955	1.6	2.1	1.3	1.6	1.8	2.1	7.1	71.0	71.5	26.2	9.4	7.0
1956	13.9	5.5	2.4	6.1	12.4	9.1	25.0	85.3	52.0	22.4	7.8	4.7
1957	2.6	2.2	2.5	2.4	8.9	18.9	14.1	24.4	11.6	3.9	3.3	2.6
1958	1.8	2.9	1.9	1.5	7.0	9.1	22.1	37.7	31.7	28.0	6.2	4.3
1959	2.2	1.4	2.1	2.6	6.0	4.9	8.7	18.0	21.5	13.3	7.8	6.0
1960	2.7	1.6	2.6	4.1	7.2	5.3	8.6	22.7	28.0	9.6	6.0	3.2
1961	1.9	1.3	1.3	1.9	3.3	3.5	6.2	49.3	35.1	21.0	106.9	68.3
1962	38.1	12.0	7.6	8.0	33.7	16.8	21.4	53.8	50.6	21.7	14.0	7.2
1963	6.1	4.0	4.0	14.5	75.0	27.0	22.9	57.9	27.4	11.2	8.3	47.8
1964	12.3	5.3	5.4	11.1	12.1	7.5	34.1	124.8	64.0	40.7	15.1	9.6
1965	6.8	3.3	3.0	3.6	4.6	2.6	3.1	4.9	2.5	3.8	4.6	2.6
1966	1.5	1.1	1.2	8.6	7.5	4.9	7.8	23.6	33.6	7.8	4.8	2.3
1967	1.2	1.0	0.9	2.5	36.0	16.1	58.6	54.2	29.1	18.8	12.9	17.9
1968	3.1	4.3	8.0	13.1	24.8	14.1	15.7	48.1	8.2	4.8	2.3	12.3
1969	3.7	3.9	4.0	2.5	6.2	3.4	5.8	11.0	15.2	6.2	4.0	2.5
1970	4.0	4.1	3.3	9.4	20.7	12.4	12.7	51.8	43.9	19.6	9.2	5.6
1971	3.6	2.2	1.6	2.0	4.6	9.7	23.9	42.0	31.5	18.4	7.7	5.5
1972	4.4	4.5	2.3	1.7	5.4	8.4	25.8	30.7	15.1	11.0	18.9	11.9
1973	5.5	3.0	1.9	1.3	2.6	4.5	3.8	16.4	16.4	8.8	6.0	3.1
1974	2.0	1.1	1.5	2.7	2.9	3.6	11.6	17.4	16.7	7.2	3.3	1.9
1975	1.3	0.8	1.1	2.9	8.3	14.6	21.2	95.3	67.4	34.2	11.5	7.2
1976	4.0	2.4	1.7	2.0	4.6	4.5	11.7	12.4	16.9	5.2	3.2	2.2
1977	2.3	1.8	1.3	15.1	88.7	40.3	73.6	70.6	38.5	36.5	127.4	46.3
1978	22.7	19.6	53.5	41.0	26.6	18.8	53.1	85.8	74.0	36.2	19.7	14.6
1979	8.6	20.3	13.0	14.5	15.0	17.8	24.0	43.1	15.6	8.7	4.9	3.2
1980	1.9	1.5	1.4	4.5	17.0	12.8	28.6	18.5	13.2	5.5	3.8	2.3
1981	1.5	1.1	4.3	35.5	25.5	13.1	24.3	68.5	43.3	22.4	10.0	5.5

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (4/13)

STATION NAME	: 1DA2	RIVER SYSTEM	: NZOIA RIVER
STATION ID NUMBER	: 10412	NAME OF RIVER	: NZOIA RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: WESTERN
CATCHMENT AREA	: 8417.0 (SQ.KM)		
PERIOD FOR APPLIED	: 35 (YEARS)	FIRST YEAR	: 1947

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1947	20.1	17.9	17.8	42.6	114.4	68.5	118.3	144.3	143.7	103.3	38.2	31.4
1948	17.3	10.6	12.0	11.1	23.8	40.5	51.1	94.6	95.2	49.3	37.4	21.5
1949	12.2	8.5	6.1	10.8	14.0	37.9	46.9	82.1	109.5	47.1	22.9	16.1
1950	10.9	6.2	5.9	12.5	12.1	15.4	44.5	75.4	75.3	48.8	22.2	13.0
1951	8.8	6.7	5.8	29.5	49.3	55.0	48.7	128.5	56.7	49.0	58.8	91.4
1952	37.2	19.6	13.3	40.2	132.8	55.7	74.2	122.5	111.6	92.1	37.1	18.7
1953	11.4	7.2	5.6	10.9	20.5	19.6	23.7	45.2	18.5	16.3	11.6	7.6
1954	5.7	3.2	3.1	9.5	20.7	24.8	42.0	85.4	101.8	34.7	14.9	14.1
1955	6.9	9.4	5.7	9.1	12.4	9.9	23.0	93.9	125.8	77.3	32.6	18.6
1956	23.2	13.0	7.7	16.0	36.1	32.4	59.0	127.2	102.9	69.8	28.7	16.4
1957	10.2	9.5	8.8	14.1	43.5	72.3	54.3	76.3	44.3	16.2	15.8	13.1
1958	7.1	10.7	6.6	5.7	20.1	26.7	57.6	80.6	83.5	53.7	18.2	15.2
1959	9.0	6.6	9.4	9.4	26.9	17.0	29.4	48.5	58.8	39.6	24.9	16.9
1960	7.7	5.5	12.7	19.9	30.7	25.0	34.1	63.1	83.1	39.9	21.3	11.9
1961	6.7	5.0	3.9	6.8	15.9	14.9	33.4	112.7	84.1	79.7	205.1	136.8
1962	95.1	34.9	28.1	34.2	106.7	76.8	104.4	144.7	149.3	73.8	40.2	29.0
1963	23.6	19.1	18.7	51.8	177.1	89.5	71.2	128.1	75.7	34.1	33.9	105.9
1964	34.9	21.0	21.3	39.4	42.5	40.5	84.8	190.6	170.5	122.4	48.8	33.0
1965	24.3	15.7	13.2	18.0	24.4	14.6	19.0	20.1	15.0	22.4	28.5	14.0
1966	7.1	8.1	9.5	35.3	27.6	19.9	31.9	63.4	91.7	33.8	30.8	13.1
1967	7.9	6.9	5.8	15.0	90.0	58.7	134.6	152.6	92.3	62.1	65.4	50.4
1968	19.2	23.1	36.4	38.3	69.6	51.2	61.6	136.5	55.2	34.9	28.5	32.9
1969	15.8	17.6	16.1	11.1	29.3	19.1	29.6	51.3	64.2	24.6	20.0	12.1
1970	15.8	14.0	13.9	33.2	53.9	41.3	48.7	147.8	140.8	73.1	40.6	22.4
1971	16.2	11.2	8.2	16.8	31.7	51.5	75.9	111.1	102.8	79.7	38.4	23.5
1972	17.5	20.5	15.8	14.1	38.2	52.6	108.4	84.0	48.6	40.6	62.7	29.5
1973	19.4	14.1	9.4	8.3	17.3	28.9	23.7	68.5	61.2	35.7	33.3	14.6
1974	9.9	6.6	8.7	14.0	16.5	19.6	53.5	64.2	70.6	39.1	19.4	11.2
1975	7.2	5.8	7.3	15.7	31.9	50.3	80.7	198.7	181.3	120.9	49.7	26.7
1976	17.4	12.2	9.3	12.8	32.9	32.8	56.2	60.9	69.3	21.9	14.8	11.6
1977	11.3	9.9	7.8	46.3	149.0	90.2	104.8	134.0	97.8	71.3	221.0	106.1
1978	53.6	56.3	94.4	55.6	80.7	64.2	130.8	165.0	138.8	91.4	59.2	38.4
1979	26.1	51.7	30.7	46.9	37.4	53.4	57.3	85.3	38.5	27.1	18.8	13.2
1980	10.0	8.8	8.7	14.3	48.6	36.7	47.5	44.7	38.9	18.3	16.6	10.5
1981	7.6	6.6	24.0	118.0	75.2	34.8	64.0	148.0	133.3	71.9	35.4	20.4

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (5/13)

STATION NAME	: 1EB1	RIVER SYSTEM	: NZOIA RIVER
STATION ID NUMBER	: 10551	NAME OF RIVER	: NZOIA RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 11849.0 (SQ.KM)		
PERIOD FOR APPLIED	: 35 (YEARS)	FIRST YEAR	: 1947

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1947	52.0	46.4	44.7	89.1	208.5	124.4	174.3	206.1	213.8	153.3	64.4	53.5
1948	30.9	20.9	23.6	21.5	42.8	72.9	79.1	136.8	137.0	76.1	60.2	33.8
1949	20.5	15.2	11.3	29.4	28.2	59.9	66.7	114.4	158.8	73.5	36.4	28.7
1950	19.6	12.0	17.4	28.0	30.2	35.0	78.2	110.3	122.9	75.8	36.0	23.2
1951	16.5	15.0	17.0	72.6	102.5	102.2	81.0	182.6	90.9	83.0	101.7	141.3
1952	65.9	39.9	29.1	84.2	233.4	105.9	125.8	185.8	168.3	134.2	62.9	35.0
1953	22.4	15.8	13.8	30.8	40.5	37.8	38.9	67.0	34.3	28.2	22.2	16.7
1954	11.7	8.0	8.0	28.0	48.0	51.5	70.4	126.9	142.2	58.0	27.5	26.5
1955	15.7	23.4	12.3	20.1	27.3	22.6	41.5	137.1	194.8	128.3	62.0	40.1
1956	49.8	29.2	20.7	41.5	71.9	64.9	89.2	173.7	159.3	114.2	52.9	32.7
1957	23.3	21.9	21.7	41.5	99.0	118.2	89.6	126.0	85.4	35.3	32.6	31.9
1958	17.8	28.6	17.5	16.8	55.1	53.7	94.2	129.6	136.1	93.9	37.3	32.9
1959	21.1	18.4	28.5	30.0	57.2	36.3	49.6	76.2	90.5	72.8	51.4	30.1
1960	18.7	15.1	37.2	63.3	71.7	56.2	68.1	110.6	151.3	81.7	53.0	29.2
1961	17.9	16.1	16.8	36.0	49.6	39.3	58.5	172.1	149.2	139.8	316.0	255.4
1962	184.3	81.2	71.9	90.7	209.5	154.5	176.1	229.6	235.5	139.2	86.8	68.4
1963	62.2	55.5	50.8	106.8	356.2	165.5	127.9	173.0	86.0	59.4	69.8	153.4
1964	61.9	33.4	48.6	100.2	110.3	103.6	126.4	249.2	230.0	185.5	83.3	67.8
1965	50.7	32.7	24.8	41.4	72.8	38.5	40.4	42.6	30.5	45.1	75.5	49.8
1966	28.7	35.4	51.5	106.9	85.7	53.2	62.2	87.9	128.2	70.6	60.7	26.8
1967	19.3	18.8	17.6	39.6	167.4	123.3	194.1	205.0	143.1	112.1	126.6	90.5
1968	41.8	54.7	76.8	94.9	217.5	145.8	119.5	198.5	98.6	62.8	60.2	64.2
1969	38.5	71.3	44.7	36.9	92.7	59.8	59.6	79.0	81.1	43.1	38.7	35.8
1970	48.4	43.0	61.7	105.6	135.9	117.6	116.6	246.3	202.7	158.6	110.8	47.3
1971	34.1	28.6	25.5	62.6	119.7	128.5	133.4	196.6	186.0	154.3	88.3	48.5
1972	34.7	41.9	33.8	23.3	67.4	85.5	141.9	169.6	93.9	84.5	169.1	79.1
1973	59.3	40.1	34.1	36.5	59.2	81.9	68.6	130.5	148.9	99.7	109.8	45.0
1974	32.9	22.2	27.7	89.0	83.4	72.4	126.6	97.7	140.5	87.4	49.8	30.8
1975	22.8	18.1	24.1	48.3	59.0	81.4	124.8	283.4	283.8	207.7	90.7	57.3
1976	39.8	29.4	23.2	38.8	79.5	64.3	94.5	105.4	123.4	50.3	40.1	33.2
1977	21.4	22.4	18.8	82.8	214.7	152.2	170.5	197.2	150.0	113.2	305.7	152.1
1978	75.1	74.2	144.8	103.0	189.0	117.1	177.6	210.2	188.8	130.4	94.6	67.4
1979	48.5	88.4	64.5	83.8	95.5	130.6	104.9	119.5	68.0	52.7	40.1	29.2
1980	25.5	22.9	23.7	37.0	99.1	85.8	91.3	72.6	78.0	39.8	41.3	26.7
1981	19.6	16.7	41.4	186.3	183.3	70.8	90.7	180.7	192.5	111.4	71.6	40.5

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (6/13)

STATION NAME	: IFB1	RIVER SYSTEM	: YALA RIVER
STATION ID NUMBER	: 10651	NAME OF RIVER	: YALA RIVER
REGION NUMBER	: W	NAME OF PROVINCE	: WESTERN
CATCHMENT AREA	: 1896.0 (SQ.KM)		
PERIOD FOR APPLIED	: 14 (YEARS)	FIRST YEAR	: 1961

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1961	5.2	4.5	5.1	14.2	15.9	11.0	12.7	39.9	42.9	37.2	63.6	69.3
1962	53.6	20.5	21.2	26.8	57.1	44.8	44.3	52.7	52.9	37.8	26.8	23.6
1963	23.5	17.6	15.0	27.4	67.8	43.1	33.0	39.8	31.0	17.6	17.5	33.8
1964	15.0	12.2	14.8	25.5	24.7	22.0	28.3	59.6	49.2	50.4	22.3	17.2
1965	13.1	8.8	7.2	12.8	16.8	9.9	11.3	11.1	9.4	11.2	16.7	10.2
1966	6.1	9.2	13.0	25.8	19.5	15.4	16.0	18.7	28.7	14.7	13.0	8.0
1967	5.1	4.4	4.0	11.8	25.8	16.9	27.1	31.9	27.4	21.4	28.0	22.4
1968	11.9	14.5	18.3	30.9	45.4	36.6	35.4	46.0	29.2	21.1	19.6	22.3
1969	18.4	17.8	13.1	10.7	17.0	15.7	16.3	23.3	27.7	15.8	13.8	9.9
1970	12.0	10.5	11.5	20.3	27.9	23.2	18.2	42.3	39.2	29.9	17.5	12.7
1971	10.9	7.9	6.8	12.3	22.4	19.9	27.7	53.1	49.3	29.9	16.7	13.0
1972	11.3	12.8	7.6	8.7	18.0	20.0	33.7	29.4	23.5	20.5	32.6	17.7
1973	16.8	13.6	8.9	10.1	14.3	22.6	13.7	37.3	34.3	24.8	19.6	10.7
1974	8.5	5.7	7.3	17.4	12.9	15.3	34.3	19.2	31.1	19.5	12.2	8.8

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (7/13)

STATION NAME	: 1FG1	RIVER SYSTEM	: YALA RIVER
STATION ID NUMBER	: 10671	NAME OF RIVER	: YALA RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA/WESTERN
CATCHMENT AREA	: 2388.0 (SQ.KM)		
PERIOD FOR APPLIED	: 35 (YEARS)	FIRST YEAR	: 1947

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1947	22.9	19.8	18.8	35.3	80.5	43.7	44.0	49.4	56.9	38.6	18.1	15.0
1948	8.5	16.0	7.1	6.2	12.5	23.2	19.7	31.7	31.2	18.7	15.4	7.5
1949	4.8	3.7	2.8	12.2	9.0	14.8	13.1	23.3	37.8	18.4	8.4	7.8
1950	5.0	3.1	7.0	9.8	11.8	12.9	24.5	25.4	36.3	18.9	8.6	6.0
1951	4.4	4.8	6.8	32.4	41.5	35.9	23.2	42.3	24.7	24.7	32.2	38.5
1952	20.3	13.4	10.2	33.1	87.0	38.6	40.1	50.8	44.5	31.6	17.8	10.5
1953	6.6	4.9	4.7	13.2	13.3	11.9	9.7	14.7	10.1	7.2	6.4	5.3
1954	3.3	2.5	2.6	12.1	19.2	18.5	20.1	31.1	30.0	15.9	7.7	7.7
1955	5.1	8.7	3.7	6.6	9.4	7.8	12.2	32.6	55.9	39.6	20.8	14.5
1956	18.6	10.3	8.1	17.6	26.2	23.3	21.5	35.5	44.3	33.7	16.5	10.5
1957	8.1	7.5	8.0	19.1	43.7	34.8	25.8	38.4	30.6	12.6	10.8	12.4
1958	6.5	11.6	6.6	6.7	25.5	18.7	26.9	37.7	40.8	30.0	12.5	11.6
1959	7.4	7.1	12.6	13.7	21.6	12.7	13.4	19.4	22.6	24.0	18.4	8.3
1960	6.6	5.6	16.8	32.6	30.7	22.3	24.7	36.4	55.1	31.3	22.7	11.2
1961	6.8	6.6	8.0	20.6	24.4	16.7	17.4	47.2	52.2	47.8	97.0	105.3
1962	75.7	34.8	33.1	44.3	89.3	64.1	58.7	71.4	72.3	52.8	35.4	29.3
1963	28.6	26.3	23.1	42.9	93.8	58.8	45.6	53.9	43.1	26.7	29.1	54.5
1964	22.4	17.4	21.9	46.5	40.7	36.3	41.6	75.2	61.6	65.5	30.0	26.0
1965	17.7	11.3	11.1	20.0	27.4	14.0	16.4	14.3	12.9	16.2	25.0	16.8
1966	9.3	14.7	20.4	39.7	31.7	24.8	22.6	27.2	40.4	20.6	20.6	11.1
1967	7.2	7.0	7.0	18.9	35.7	26.4	37.5	45.3	40.2	33.5	40.0	36.8
1968	17.8	23.3	30.1	52.0	69.3	54.2	46.2	58.9	43.7	33.2	30.2	27.9
1969	20.4	26.9	21.9	15.5	31.3	26.5	24.3	36.1	37.3	25.3	21.4	12.8
1970	18.8	15.4	17.6	32.1	42.3	39.9	31.0	55.3	52.3	42.8	28.5	19.3
1971	14.4	8.9	6.9	21.3	38.6	36.7	39.7	63.7	62.2	45.4	27.2	21.4
1972	14.9	18.8	11.8	12.6	36.7	35.2	47.6	47.1	37.5	37.7	52.4	33.4
1973	30.1	25.0	14.7	16.9	30.5	39.2	26.0	52.1	52.6	39.2	34.8	17.6
1974	13.6	9.1	11.2	27.4	20.5	23.5	48.7	32.9	44.9	34.7	22.7	14.5
1975	10.0	7.5	10.9	23.4	19.0	22.1	33.3	71.3	88.5	73.3	30.5	21.8
1976	15.2	11.0	8.7	18.0	35.6	22.5	28.4	33.7	42.1	20.0	17.4	14.5
1977	6.0	7.6	6.6	26.7	53.1	49.3	53.1	50.7	40.4	31.5	70.9	35.1
1978	29.6	28.9	44.5	44.1	66.6	43.9	50.0	60.7	55.9	47.3	38.5	29.6
1979	20.8	39.9	30.0	32.2	31.4	44.2	43.2	71.5	40.9	27.1	21.5	15.8
1980	10.8	10.6	10.7	20.8	31.9	26.4	33.9	33.5	31.9	20.3	15.5	10.0
1981	6.9	6.4	16.4	52.5	36.1	23.8	36.6	52.8	51.5	35.5	21.9	16.7

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (8/13)

STATION NAME	: 1GD1/3/4	RIVER SYSTEM	: NYANDO RIVER
STATION ID NUMBER	: 10741	NAME OF RIVER	: NYANDO RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 2600.0 (SQ.KM)		
PERIOD FOR APPLIED	: 35 (YEARS)	FIRST YEAR	: 1949

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1949	2.2	2.4	0.9	5.8	8.4	9.1	8.8	19.3	22.3	6.4	2.6	2.7
1950	1.8	1.1	4.9	5.2	4.6	5.2	20.4	21.0	21.2	8.5	2.8	1.9
1951	1.4	1.5	1.6	66.3	39.2	20.6	8.2	17.5	8.3	7.8	13.3	39.7
1952	10.5	4.6	3.0	40.7	87.1	16.3	10.5	17.1	31.2	8.8	7.0	2.0
1953	1.9	1.3	1.0	4.7	5.9	6.1	4.6	9.6	3.2	2.1	1.8	1.8
1954	1.1	0.8	0.8	4.1	29.9	12.8	22.5	28.2	35.2	7.9	2.8	2.4
1955	1.4	3.0	3.3	10.0	13.3	2.8	4.4	26.2	36.0	20.7	5.8	4.9
1956	14.4	7.6	6.0	14.8	22.0	14.1	21.9	41.0	27.9	14.4	5.3	3.5
1957	2.3	2.6	2.4	15.4	21.6	41.8	14.3	19.5	11.1	3.8	3.2	2.4
1958	1.8	4.7	4.7	2.3	19.6	10.6	22.2	18.8	17.7	8.7	3.1	3.8
1959	2.5	1.9	4.4	10.9	15.9	4.2	3.2	5.2	10.6	7.3	11.3	4.7
1960	2.4	1.8	15.4	47.9	28.9	10.6	8.0	12.4	19.1	8.0	8.3	2.9
1961	1.0	1.0	2.1	5.6	7.5	3.7	3.6	23.9	22.4	13.5	83.8	97.1
1962	52.3	10.3	8.7	26.1	54.5	31.0	24.6	30.5	29.4	17.6	9.0	8.1
1963	7.9	6.9	7.5	21.7	57.8	27.0	11.8	22.9	13.1	5.2	10.5	27.6
1964	6.2	4.6	4.7	45.8	25.1	16.5	29.3	38.0	35.7	27.2	10.4	7.9
1965	6.4	4.5	4.2	6.2	6.5	3.7	3.6	4.4	3.4	3.6	6.1	4.4
1966	2.2	5.4	9.1	23.4	11.2	8.5	9.6	11.2	19.6	5.8	5.8	3.2
1967	2.1	2.4	2.2	9.2	25.8	17.5	50.8	33.8	18.8	8.0	26.6	31.6
1968	6.0	18.1	22.4	55.7	56.8	36.2	28.2	48.7	15.8	8.2	7.2	12.0
1969	4.6	18.4	15.1	5.7	10.4	5.7	5.3	8.2	9.5	3.9	3.7	2.7
1970	11.2	8.1	17.9	34.3	35.0	21.6	12.5	42.1	32.1	15.3	8.1	5.1
1971	5.2	2.7	1.9	10.1	26.5	22.3	28.5	36.8	36.5	17.2	6.8	6.6
1972	4.4	5.7	3.2	3.6	13.8	20.5	18.2	14.7	7.5	20.1	36.7	12.0
1973	13.5	16.4	6.5	5.4	10.6	14.7	8.1	23.7	23.9	11.1	7.0	3.9
1974	3.2	2.0	2.9	44.9	13.8	15.8	44.1	17.2	16.2	9.4	5.9	3.4
1975	2.4	2.0	5.1	12.3	9.8	14.2	22.9	53.9	64.0	35.0	11.5	8.2
1976	4.7	3.4	2.6	4.7	9.1	9.5	18.4	15.8	16.1	4.4	4.0	3.2
1977	3.9	5.8	3.4	22.7	57.2	33.9	40.0	36.7	23.5	12.7	69.3	22.8
1978	13.6	15.7	46.0	39.2	46.4	19.8	31.0	37.9	31.9	26.0	12.6	14.3
1979	9.3	66.8	26.7	23.7	26.6	32.4	21.9	40.1	14.9	7.6	8.2	5.2
1980	5.4	3.4	3.2	17.8	29.9	16.4	17.4	10.8	8.8	4.5	4.4	3.4
1981	2.6	2.3	5.4	48.8	33.2	7.6	17.8	49.7	30.9	19.8	7.5	4.7
1982	2.7	3.6	2.0	10.1	27.9	18.1	9.1	26.3	11.9	10.0	36.1	45.6
1983	9.2	5.8	4.2	10.2	12.8	12.4	12.4	32.1	36.8	43.9	16.8	8.9

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (9/13)

STATION NAME	: 1JG1	RIVER SYSTEM	: SONDU RIVER
STATION ID NUMBER	: 11071	NAME OF RIVER	: SONDU RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 3260.0 (SQ.KM)		
PERIOD FOR APPLIED	: 37 (YEARS)	FIRST YEAR	: 1947

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1947	13.2	11.8	15.6	99.6	265.0	79.8	52.1	56.3	59.9	54.0	13.4	8.5
1948	5.3	3.5	2.8	5.2	9.6	25.3	26.6	57.3	64.4	19.0	10.3	2.8
1949	3.5	2.8	1.7	4.2	5.5	13.5	15.8	36.1	57.6	23.5	10.9	9.3
1950	6.6	3.9	5.7	14.1	20.9	22.6	35.4	44.8	57.9	24.2	10.5	7.0
1951	4.5	4.7	4.2	110.5	92.0	87.6	35.2	45.1	28.5	31.4	45.8	123.5
1952	60.3	14.7	8.7	44.8	201.5	65.5	29.0	52.9	46.6	25.7	15.7	10.6
1953	5.5	3.2	2.3	6.2	9.9	10.8	9.9	12.0	9.7	7.1	6.7	6.5
1954	3.3	1.7	1.6	5.9	45.8	75.3	39.0	34.1	56.1	26.9	13.3	11.0
1955	5.9	5.6	3.1	6.8	16.3	10.3	16.5	45.2	36.0	63.4	25.0	19.2
1956	41.6	31.6	14.5	36.8	104.1	75.3	48.2	54.0	86.6	40.6	27.7	16.7
1957	8.6	7.0	6.6	47.7	114.0	149.8	63.3	53.4	45.5	15.3	10.6	9.4
1958	6.5	9.7	9.7	9.8	67.0	33.8	34.7	32.8	45.3	27.8	13.9	11.5
1959	8.6	6.6	11.7	37.0	69.5	35.2	16.1	18.3	28.6	22.8	23.3	14.5
1960	9.7	6.2	17.9	70.1	62.6	55.3	36.6	40.1	78.8	43.5	23.2	13.1
1961	6.8	4.5	4.3	9.7	24.1	15.6	12.9	33.0	46.3	56.6	258.8	227.2
1962	85.6	26.7	12.7	32.7	182.6	111.8	88.6	45.8	86.2	73.2	31.1	18.0
1963	32.0	25.0	21.2	74.1	265.0	118.4	35.0	51.3	37.6	11.0	12.7	88.1
1964	33.8	13.4	25.4	183.6	108.5	49.0	69.1	71.9	60.7	75.3	22.1	11.4
1965	10.0	6.4	4.0	32.5	72.7	23.6	15.4	16.4	17.0	11.8	31.6	22.1
1966	11.0	11.3	32.4	89.5	80.9	33.3	26.4	24.6	71.1	24.1	22.9	11.9
1967	6.6	4.4	3.6	19.9	99.1	64.2	75.5	40.1	30.8	17.0	21.2	57.1
1968	15.3	17.2	51.4	122.9	161.0	92.6	57.4	93.6	46.8	17.8	29.3	93.3
1969	22.8	48.9	39.5	29.9	37.7	23.7	14.2	16.9	34.9	14.2	9.6	6.9
1970	14.3	22.6	66.7	126.2	115.7	82.6	42.5	79.9	79.5	59.1	27.1	11.9
1971	10.5	6.9	4.6	11.2	41.8	66.5	64.1	100.4	93.9	46.2	16.8	10.4
1972	10.3	9.2	7.4	7.7	32.4	41.4	45.9	44.4	26.7	19.8	74.8	47.2
1973	43.6	32.6	20.1	12.5	33.2	80.7	31.4	48.7	62.9	36.6	30.0	13.4
1974	7.1	4.5	5.7	71.2	51.2	56.6	130.9	67.0	55.0	42.8	24.2	11.0
1975	6.2	4.4	5.5	28.8	33.3	50.5	42.4	94.4	136.6	81.9	36.8	14.4
1976	8.9	6.2	5.4	8.4	22.8	41.6	58.0	50.9	73.2	21.7	11.3	9.1
1977	11.7	24.0	13.9	89.6	164.0	81.0	109.9	78.3	53.4	26.1	109.9	78.3
1978	31.3	28.2	168.1	198.2	153.5	46.5	58.5	55.9	70.5	73.8	40.7	28.6
1979	21.2	69.6	48.1	69.5	92.7	75.2	56.3	63.4	35.4	15.3	10.1	7.7
1980	5.9	5.2	7.7	14.8	39.4	55.9	64.6	33.4	32.3	14.0	13.2	10.4
1981	5.7	6.3	12.5	142.1	97.5	33.4	40.3	79.3	62.3	56.7	22.0	13.1
1982	7.6	4.5	2.7	4.8	44.0	72.2	36.9	65.1	50.2	35.8	122.3	163.9
1983	26.8	11.7	7.5	17.0	48.9	50.5	42.8	55.2	107.7	80.2	51.8	24.5

Source: Sondu River Multipurpose Development Project, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (10/13)

STATION NAME	: 1KB1/1A	RIVER SYSTEM	: KUJA/MIGORI RIVER
STATION ID NUMBER	: 11121	NAME OF RIVER	: KUJA RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 3115.0 (SQ.KM)		
PERIOD FOR APPLIED	: 33 (YEARS)	FIRST YEAR	: 1951

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	1.3	2.0	3.9	95.8	64.6	41.3	40.8	10.6	7.1	10.8	86.1	228.8
1952	59.3	12.4	12.3	80.5	350.0	111.1	37.5	21.7	29.7	16.3	9.8	5.5
1953	2.6	1.3	1.8	6.2	22.7	9.5	7.3	3.3	2.9	4.8	8.7	6.3
1954	1.3	0.8	0.7	16.0	84.8	35.9	18.8	7.6	9.0	14.8	2.3	6.4
1955	1.0	4.3	3.2	11.4	74.0	17.1	9.4	12.8	37.4	57.7	17.3	8.9
1956	11.4	10.7	7.6	17.6	333.6	42.9	11.3	13.3	19.3	23.4	24.0	18.1
1957	6.9	8.5	15.9	41.0	69.6	80.8	20.0	5.4	4.9	4.7	3.9	5.1
1958	6.5	9.5	9.3	22.7	118.8	19.7	7.2	15.0	37.6	27.0	8.5	16.0
1959	5.4	5.2	22.5	17.8	29.2	10.5	4.8	6.1	13.4	16.4	15.1	15.0
1960	7.2	5.4	38.2	170.0	58.0	28.9	7.9	5.3	16.8	12.9	13.3	6.2
1961	3.3	4.6	4.9	23.3	89.8	16.4	5.3	7.9	23.8	49.5	479.0	107.9
1962	45.9	10.2	18.5	43.3	124.9	78.2	65.0	32.5	77.3	84.9	33.6	44.4
1963	41.4	19.4	28.0	67.1	151.4	47.2	20.5	17.3	20.5	9.7	23.1	65.2
1964	21.8	17.7	15.5	85.8	73.0	26.6	15.4	17.3	17.8	41.2	11.3	16.8
1965	13.7	5.9	7.0	21.2	77.5	21.9	9.9	5.6	6.6	7.2	25.3	33.4
1966	11.3	18.0	60.1	107.7	68.4	17.6	10.1	6.5	29.7	13.0	26.5	7.8
1967	4.1	3.6	3.0	47.2	121.0	43.9	25.1	9.5	7.6	19.7	65.5	102.7
1968	11.0	16.0	80.3	101.5	119.0	41.4	16.8	13.1	26.1	9.3	23.2	83.4
1969	26.3	67.1	50.1	28.6	68.1	24.1	10.6	8.1	9.7	10.0	10.6	9.7
1970	12.4	12.5	45.1	115.6	88.4	54.2	17.3	20.1	22.9	23.0	13.6	9.4
1971	6.2	3.5	2.8	35.6	60.2	42.8	16.8	24.8	29.8	17.2	12.1	10.4
1972	9.8	8.6	6.7	6.2	36.8	30.8	13.0	11.5	9.2	27.1	116.0	60.0
1973	48.5	18.3	8.5	15.1	55.7	77.2	12.8	12.9	56.1	39.1	67.4	17.0
1974	7.2	4.5	7.0	186.5	70.4	29.4	65.6	19.4	42.4	32.8	16.3	7.7
1975	5.3	3.0	7.9	42.2	57.5	53.2	29.8	20.5	50.8	42.5	16.1	15.7
1976	6.2	5.6	5.4	13.8	45.1	55.0	37.5	25.9	41.7	14.9	9.9	9.3
1977	15.0	15.4	12.2	106.6	154.7	40.7	36.6	22.8	52.2	20.5	96.2	59.1
1978	32.5	32.1	185.2	135.1	66.9	23.9	13.2	19.0	43.5	31.7	36.2	21.3
1979	25.4	63.2	48.7	89.2	89.0	37.0	13.7	12.0	9.1	4.7	8.1	7.4
1980	6.4	4.9	11.0	21.5	92.3	48.1	31.6	12.0	18.0	12.2	8.8	8.7
1981	1.4	5.2	10.9	102.3	112.2	28.2	22.6	16.9	29.3	23.1	13.6	8.6
1982	5.4	6.9	5.6	39.8	98.9	64.9	21.6	30.0	21.2	33.5	183.0	145.8
1983	32.9	27.5	21.7	50.4	84.7	29.9	23.2	17.1	42.3	78.5	59.4	35.5

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (11/13)

STATION NAME	: 1KB5	RIVER SYSTEM	: KUJA/MIGORI RIVER
STATION ID NUMBER	: 11125	NAME OF RIVER	: KUJA/MIGORI RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 6600.0 (SQ.KM)		
PERIOD FOR APPLIED	: 33 (YEARS)	FIRST YEAR	: 1951

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	1.8	2.7	5.2	132.4	88.6	56.3	14.6	14.3	9.5	14.6	118.7	323.1
1952	81.3	16.7	16.6	110.9	500.9	154.0	51.1	29.4	40.3	22.0	13.2	7.4
1953	3.5	1.8	2.5	8.4	30.7	12.8	9.9	4.5	3.9	6.4	11.8	8.5
1954	1.8	1.1	1.0	21.6	116.9	48.8	25.4	10.3	12.1	19.7	3.1	8.6
1955	1.3	5.8	4.3	15.3	101.8	23.1	12.7	17.2	50.9	79.0	23.3	12.0
1956	55.1	59.6	13.4	26.9	395.0	68.4	20.2	18.5	34.2	30.3	28.6	25.4
1957	14.5	11.8	19.1	72.4	113.9	157.8	41.3	11.2	6.4	5.7	5.0	10.4
1958	10.0	13.9	20.9	36.7	216.5	30.2	9.8	17.9	42.6	29.2	10.2	18.1
1959	6.5	7.0	48.4	26.0	31.5	12.3	5.6	7.6	15.6	19.5	20.1	19.5
1960	9.9	8.4	66.7	218.0	77.3	35.7	9.4	6.2	25.5	16.7	21.3	9.0
1961	4.1	9.6	8.7	39.1	129.1	24.4	6.9	9.4	27.6	54.3	693.1	149.5
1962	62.6	13.8	45.1	93.5	261.1	133.2	79.1	38.1	96.0	109.8	53.9	78.4
1963	60.3	42.3	50.6	124.0	256.9	96.5	34.2	22.8	26.0	10.9	59.6	187.7
1964	50.0	63.2	120.9	456.3	132.0	41.0	21.4	23.3	30.2	61.6	18.2	26.1
1965	25.1	10.6	9.4	30.1	108.6	30.9	12.8	7.9	8.7	9.3	30.0	60.4
1966	21.3	41.3	133.1	172.8	98.1	21.1	12.2	8.4	37.5	15.3	31.2	9.3
1967	5.1	4.6	3.8	75.6	172.5	56.2	30.4	11.3	10.2	23.1	89.2	158.2
1968	16.4	36.2	159.5	199.0	161.9	51.9	22.7	17.6	30.1	12.5	30.2	106.9
1969	51.5	130.3	70.9	36.0	108.3	35.9	11.6	9.3	11.6	11.6	13.1	14.9
1970	25.0	25.5	89.0	198.0	161.6	100.8	24.9	24.6	27.4	33.0	19.7	15.2
1971	11.5	4.8	2.9	63.6	123.0	63.0	21.2	38.5	41.0	24.5	16.7	15.8
1972	20.9	21.0	19.7	9.1	40.2	45.9	22.0	16.4	13.6	40.2	147.7	107.0
1973	111.7	33.2	11.7	23.6	74.3	92.7	17.8	14.5	72.5	39.2	91.2	26.9
1974	11.2	5.0	10.8	306.5	86.4	36.2	93.2	26.1	50.2	37.6	20.0	19.8
1975	6.7	4.1	13.4	57.3	70.8	68.8	36.6	26.4	60.3	48.7	18.3	15.3
1976	8.7	8.3	9.0	28.4	76.7	86.5	66.3	38.0	53.1	21.0	16.4	26.0
1977	24.8	37.9	21.6	197.3	374.1	96.2	36.0	20.9	30.9	14.2	126.1	72.2
1978	36.5	54.9	320.0	239.6	121.8	30.5	12.3	20.5	22.0	25.4	42.6	77.8
1979	47.8	73.3	69.3	170.3	118.1	51.5	19.3	19.3	12.8	7.5	12.3	11.6
1980	9.7	9.9	19.3	52.8	115.0	81.8	38.4	10.6	19.9	14.0	11.3	10.8
1981	2.9	7.2	16.8	168.9	158.2	38.4	26.7	19.6	32.7	26.7	18.4	11.6
1982	7.3	9.4	6.9	60.8	127.0	93.1	25.2	34.5	25.6	37.2	253.6	210.2
1983	41.6	32.1	24.8	60.9	98.8	33.0	25.4	19.4	48.3	86.9	72.0	53.6

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (12/13)

STATION NAME	: 1KC3	RIVER SYSTEM	: KUJA/MIGORI RIVER
STATION ID NUMBER	: 11133	NAME OF RIVER	: MIGORI RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 3046.0 (SQ.KM)		
PERIOD FOR APPLIED	: 33 (YEARS)	FIRST YEAR	: 1951

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1951	0.2	0.3	0.7	36.6	22.6	13.1	2.6	2.5	1.5	2.6	32.1	105.8
1952	20.4	3.0	3.0	29.6	177.8	43.8	11.7	6.0	8.8	4.2	2.3	1.1
1953	0.4	0.2	0.3	1.3	6.3	2.2	1.6	0.6	0.5	0.9	2.0	1.3
1954	0.2	0.1	0.1	4.1	31.5	11.0	5.0	1.7	2.0	3.7	0.4	1.3
1955	0.1	0.8	0.6	2.7	26.7	4.5	2.2	3.1	11.6	19.7	4.5	2.0
1956	41.8	47.1	4.6	7.7	78.7	23.7	7.5	3.8	13.1	5.2	2.9	5.7
1957	6.4	2.2	1.8	29.7	43.6	78.1	19.4	4.8	0.8	0.3	0.5	4.3
1958	2.5	3.2	10.1	12.2	101.9	8.8	1.6	1.5	3.1	0.5	0.7	0.7
1959	0.4	1.0	24.0	6.6	1.6	0.7	0.1	0.7	0.9	1.7	3.6	3.1
1960	1.7	2.1	26.7	52.3	17.7	5.0	0.6	0.2	7.1	2.5	6.5	1.9
1961	0.3	4.1	2.9	14.0	39.2	6.4	0.8	0.6	2.1	2.9	260.7	42.3
1962	14.9	2.4	24.7	48.9	143.2	55.0	12.5	3.8	17.5	24.1	18.4	32.4
1963	17.1	21.0	20.7	56.6	112.3	48.1	11.9	4.0	3.9	1.2	34.7	125.1
1964	26.3	43.7	105.0	393.2	59.0	12.5	4.5	4.5	10.7	18.6	5.5	7.7
1965	9.8	3.7	1.5	7.2	30.2	7.3	1.8	1.5	1.2	1.2	3.0	25.2
1966	8.5	21.4	73.0	66.9	28.5	2.0	1.0	1.0	6.0	1.1	3.0	0.6
1967	0.4	0.4	0.3	26.7	53.3	10.4	3.6	0.8	1.6	1.9	22.3	56.6
1968	4.1	18.4	80.4	100.7	44.2	8.6	4.4	3.2	2.3	2.1	5.3	22.6
1969	23.3	63.1	10.4	4.9	17.8	4.0	1.2	1.2	1.1	0.8	0.6	3.4
1970	10.5	8.7	59.3	57.6	35.1	45.5	5.7	5.4	2.9	7.9	1.6	3.6
1971	2.7	1.1	0.4	21.3	52.4	10.0	2.6	19.8	6.3	4.4	1.8	3.7
1972	11.5	7.3	6.6	1.1	3.1	10.5	3.5	3.5	1.7	10.8	29.8	43.8
1973	112.4	9.0	2.1	4.3	17.0	17.6	1.5	1.1	15.3	6.0	24.7	3.3
1974	2.2	0.4	2.6	82.5	30.9	7.1	38.3	5.5	14.0	8.7	3.1	1.8
1975	0.9	0.4	4.5	14.8	10.9	14.4	8.8	3.5	7.9	6.6	1.1	2.4
1976	3.1	1.9	3.0	20.9	18.8	39.0	21.9	14.0	20.5	2.3	3.6	8.4
1977	13.4	15.5	5.3	118.0	197.9	14.9	10.1	2.6	2.1	0.8	38.2	22.2
1978	14.3	32.9	171.0	59.8	21.8	6.9	1.5	1.8	1.5	1.2	3.3	54.1
1979	15.4	36.9	21.4	62.3	18.3	7.6	2.2	1.7	1.1	1.9	1.1	2.1
1980	4.0	4.7	9.3	39.0	33.2	30.4	5.0	0.6	1.2	0.8	1.5	1.1
1981	1.1	1.2	4.6	68.2	47.1	8.4	2.5	1.3	1.6	2.0	3.4	1.9
1982	1.1	1.6	0.5	19.2	27.9	26.9	2.0	2.7	2.8	1.9	77.1	68.2
1983	6.8	2.9	1.5	8.7	13.0	1.3	0.6	0.9	4.1	7.0	10.9	16.2

Source: Lake Basin River Catchment Development -- River Profile Studies, 1985

Table 7.4 Monthly Flow Record at Major Gauge Stations (13/13)

STATION NAME	: 1LA3	RIVER SYSTEM	: MARA RIVER
STATION ID NUMBER	: 11213	NAME OF RIVER	: NYANGORES RIVER
REGION NUMBER	: 1	NAME OF PROVINCE	: NYANZA
CATCHMENT AREA	: 679.0 (SQ.KM)		
PERIOD FOR APPLIED	: 20 (YEARS)	FIRST YEAR	: 1964

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1964	6.9	2.0	3.5	42.4	28.2	9.0	24.6	21.6	13.2	22.6	4.7	1.8
1965	1.7	0.8	0.6	2.2	12.7	4.2	5.3	5.5	5.2	3.3	8.2	6.0
1966	2.1	2.4	6.2	31.4	21.6	6.2	5.0	6.7	30.2	5.5	6.9	2.7
1967	1.0	0.6	0.5	2.6	14.0	12.5	19.4	8.1	6.3	3.8	4.8	12.9
1968	2.3	2.0	5.6	41.9	59.6	21.5	9.6	18.9	8.9	3.2	5.1	12.8
1969	2.7	5.4	6.2	4.0	7.9	4.8	3.8	4.7	8.7	3.7	1.7	1.6
1970	2.5	3.7	9.2	59.0	61.8	23.8	1.8	23.8	32.7	16.0	5.8	2.4
1971	1.3	0.7	0.3	2.1	11.2	8.9	11.2	47.5	38.9	9.1	2.8	1.8
1972	1.4	3.6	2.1	1.4	4.9	5.4	7.1	8.7	10.9	5.5	14.4	9.3
1973	6.7	7.5	6.9	4.1	9.2	14.4	7.8	13.7	18.0	10.1	5.8	2.6
1974	1.0	0.8	1.5	3.7	1.2	1.1	32.6	10.2	20.3	19.4	5.4	2.4
1975	1.1	0.5	0.6	5.3	7.5	12.6	19.0	30.1	29.9	23.6	7.0	2.4
1976	1.7	0.6	0.4	1.0	2.5	5.6	10.6	9.0	13.3	4.0	2.2	1.2
1977	3.7	3.4	1.5	18.9	63.6	15.8	18.6	13.8	10.4	5.2	17.1	13.7
1978	6.1	5.3	66.6	58.3	36.0	6.4	12.1	10.5	16.5	18.6	7.7	5.6
1979	2.9	22.2	7.3	14.3	29.3	8.7	8.3	11.8	10.1	5.5	2.5	1.3
1980	0.8	0.8	1.1	4.3	9.1	8.3	14.6	6.5	6.9	3.0	3.7	2.5
1981	1.3	0.7	1.4	18.3	22.0	7.2	11.4	14.5	14.7	11.0	5.7	3.2
1982	2.0	1.1	0.5	2.3	14.3	14.0	8.5	14.5	14.3	9.3	19.3	24.3
1983	4.6	2.7	2.6	5.6	13.6	9.0	10.7	12.3	17.5	12.1	7.8	4.8

Source: Hydrology Section of Ministry of Water Development

Table 7.5 Record of Annual Maximum Discharge

(Unit: m3/sec)

Year	Stations						
	1AH1	1DA2	1EB1	1FG1	1GD1/3/4	1JG1	1KB5
1947						453	
1948		183.1		45.1		76	
1949		142.6		48.5		65	
1950		127.1		51.2		65	
1951		215.5		84.1		255	
1952		202.9		137.4		172	
1953		82.8		24.9		23	
1954		148.1		38.5		122	
1955		173.4		86.6	308	109	
1956		180.5		75.1	164	148	
1957		134.1		65.1	159	242	
1958		122.7		63.5	210	173	
1959		118.7		52.9	83	99	
1960		142.2		86.3	234	116	
1961		514.9		174.9	377	453	
1962		199.6		123.4	211	379	
1963		292.3	595.4	120.2	161	365	
1964		276.7	370.9	112.4	251	503	
1965		46.7	130.8	43.8	33	141	
1966		183.8	277.2	103.2	77	200	
1967		195.2	290.1	70.3	129	136	
1968		239.4	312.3	138.5	246	388	
1969		117.8	194.3	67.4	68	152	
1970	67.2	277.5	416.3	88.9	150	177	287.9
1971	55.7	197.1	320.0	122.3	136	152	324.5
1972	57.6	163.4	337.0	83.8	208	106	287.1
1973	47.8	129.1	234.8	74.5	132	137	383.4
1974	49.5	121.5	186.6	66.6	261	219	659.9
1975	51.0	303.0	475.8	95.2	172	175	177.7
1976	32.2	143.6	201.1	66.6	62	118	179.2
1977	52.1	528.2	560.7	122.6	363	258	743.0
1978	63.2	283.2	345.5	113.7	155	427	687.7
1979	52.9	166.2	205.0	60.3	328	138	450.0
1980	40.0	92.0	158.6	48.1	163	113	209.5
1981	59.9	242.1	356.8	100.3	132	296	
1982	62.8	202.5	382.3	88.6	193	317	
1983	60.5	267.1	337.0	96.9	105	174	
1984	53.9	58.9	100.0	63.2			
1985	68.8	130.3		68.3			

Sources : Ministry of Water Development and Sondu River Multipurpose Development Study.

Table 7.6 Probable Flood at Stream Gauges

(Unit : m^3/sec)

Return Period	Station						
	1AH1	1DA2	1EE1	1EG1	1GD1/3/4	1JG1	1KB5
2	53	177	287	78	167	186 (337)	365
5	62	266	402	107	245	296 (418)	549
10	67	326	478	126	297	369 (468)	672
20	73	383	551	144	346	439 (514)	789
25	74	401	574	150	362	462 (528)	826
50	80	457	646	168	411	530 (571)	941
100	85	512	717	185	459	598 (614)	1,055

Source: Computed by Study Team

Table 7.7 Specific Discharge of 100-year Flood

Station	1AH1	1DA2	1EE1	1FG1	1GD/3/4	1JG1	1KB5
River	Sio	Nzoia	Nzoia	Yala	Nyando	Sondu	Kuja/Migori
Catchment (km^2)	1,450	8,417	11,849	2,388	2,600	3,260	6,600
Q100 (m^3/sec)	85	512	717	185	459	598	1,055
Specific discharge (m^3/sec)	0.059	0.061	0.061	0.077	0.177	0.183	0.16

Source: Computed by Study Team.

Tabel 7.8 Suspended Load of the Rivers

River	RDS	Suspended Load	(tons/km^2/year)
			1)
Nzoia	1DA2	38	100
Yala	1FG1	63	100
Nyando	1GD3	58 to 423	100 - 30
Sondu	1JG1	150 (38)	10

Source: Lake Basin River Catchment Development River Profile Study (Vol. III, Annex A).

Table 7.9 Subbasins in the Lake Basin

Basin name	Sub-basin name	Code	Area Km2
Sio Malaba	Upper Malaba	1AA	262
	Upper Malikisi	1AB	289
	Toloso	1AC	106
	Lower Malikisi	1AD	266
	Lower Malaba	1AE	123
	Naliwatsi	1AF	398
	Upper Sio	1AG	347
	Lower Sio	1AH	535
Upper Nzoia	Moiben	1BA	664
	Upper Nzoia	1BB	749
	Noigamet	1BC	759
	Little Nzoia	1BD	695
	Kipsangwe		
	Koitobos	1BE	1,147
	Rongai	1BG	902
	Kimilili	1BH	562
Kipkarren	Sergoit	1CA	698
	Sosiani	1CB	654
	Onyokie	1CC	630
	Middle Kipkarren	1CD	518
	Lower Kipkarren	1CE	235
Middle Nzoia	Upper Middle Nzoia	1DA	528
	Kuywa	1DB	770
	Chwele	1DC	337
	Khalaba	1DD	351
Lower Nzoia	Upper Isiukhu	1EA	501
	Lower Isiukhu	1EB	323
	Upper Lusumu	1EC	232
	Lower Lusumu	1ED	136
	Lower Middle Nzoia	1EE	402
	Lower Nzoia	1EF	351
	Wuoroya	1EG	552
Yala	Keses	1FA	245
	Upper Kimondi	1FB	351
	Lower Kimondi	1FC	272
	Mokong	1FD	487
	Middle Yala	1FE	661
	Edzawa	1FF	279
	Lower Yala	1FG	967
Nyando	Ainobngituny	1GA	385
	Kundos-Mbogo	1GB	541
	Upper Nyando	1GC	865
	Lower Nyando	1GD	661
	Reresik	1GE	364
	Nyakatch	1GF	232
	South Tinderet	1GG	402
Lakeshore	Kibos	1HA	868
	Asembo-Kisumu	1HB	770
	Kadimu-Uyoma	1HC	947
	Kendu Bay	1HD	790
	Tende	1HE	781
	Ruri-Olambwe	1HF	899
Sondu	Upper Itare	1JA	783
	Lower Itare	1JB	238
	Kitoi	1JC	354
	Kabianga	1JD	211
	Sisei	1JE	575
	Kipsonoi	1JF	967
	Miriu Sondu	1JG	361
Kuja Migori	Riana	1KA	480
	Kuja	1KB	3,449
	Migori	1KC	2,939
Mara	Nyangores/Mara	1LA	4,828
	Amala	1LB	4,113

Sources: ILUS(1985) and NWMP (1980)

Table 7.10 Comparison of Estimated and Measured Annual Average Flow

Subbasin code	Estimated at Subbasin		Measured at Gauge Station		
	Accumulated basin area (km2)	Estimated flow 1) (m3/sec)	Station code	Drainage area (km2)	Flow 2) (m3/sec)
1AH	1,280	13.0	1AH1	1,450	10.5
1BD	4,014	16.9	1BD2	3,825	16.4
1CB	2,735	15.1	1CB1	2,440	15.6
1DA	8,741	47.5	1DA2	8,417	45.9
1EB	11,793	86.0	1EB1	11,849	82.7
1FB	2,016	18.9	1EF1	1,896	21.3
1FG	3,262	30.0	1FG1	2,388	27.7
1GD	2,854	27.1	1GD1/3/4	2,600	15.5
1JG	3,489	38.7	1JG1	3,260	41.6
1KC	2,939	23.2	1KC3	3046	17.7
1KB	6,868	58.4	1KB5	6600	53.2
1LA	4,828	17.2	1LA3	697	10.4

Sources : 1) Computed from subbasin runoff presented in National Master Water Plan.
2) Table 7.3

Table 7.11 Annual Mean and Low Flow Volumes

Sub-basin code	Annual Mean Flow (MCM)	Low flow once in 3-4 Years (MCM)	Low flow once in 30-40 Years (MCM)	Annual Mean Accumulated (MCM)	Low flow(3) Accumulated (MCM)	Low flow(30) Accumulated (MCM)	Low flow once in 3-4 Years % of the mean	Low flow once in 30-40 Years % of the mean
1AA	57.9	9.3	4.6	57.9	9.3	4.6	16.00%	8.00%
1AB	70.7	11.3	5.7	70.7	11.3	5.7	16.00%	8.00%
1AC	23.2	3.7	1.9	23.2	3.7	1.9	16.00%	8.00%
1AD	77.5	12.4	6.2	171.4	27.4	13.7	16.00%	8.00%
1AE	43.9	7.0	3.5	43.9	7.0	3.5	16.00%	8.00%
1AF	114.9	18.4	9.2	114.9	18.4	9.2	16.00%	8.00%
1AG	118.8	19.0	9.5	118.8	19.0	9.5	16.00%	8.00%
1AH	176.7	28.3	14.1	410.4	65.7	32.8	16.00%	8.00%
1BA	53.7	8.5	5.7	53.7	8.5	5.7	15.90%	10.60%
1BB	67.1	10.7	7.1	120.8	19.2	12.8	15.90%	10.60%
1BC	134.5	21.4	14.3	134.5	21.4	14.3	15.90%	10.60%
1BD	64.9	10.3	6.9	533.9	84.9	56.6	15.90%	10.60%
1BE	213.7	34.0	22.7	213.7	34.0	22.7	15.90%	10.60%
1BG	175.9	28.0	18.6	175.9	28.0	18.6	15.90%	10.60%
1BH	122.9	19.5	13.0	122.9	19.5	13.0	15.90%	10.60%
1CA	75.4	6.1	2.3	75.4	6.1	2.3	8.10%	3.10%
1CB	114.9	9.3	3.6	114.9	9.3	3.6	8.10%	3.10%
1CC	140.1	11.3	4.3	140.1	11.3	4.3	8.10%	3.10%
1CD	95.8	7.8	3.0	235.9	19.1	7.3	8.10%	3.10%
1CE	49.4	4.0	1.5	475.6	38.5	14.7	8.10%	3.10%
1DA	190.4	43.8	19.0	1498.7	214.7	122.0	23.00%	10.00%
1DB	220.5	50.7	22.1	220.5	50.7	22.1	23.00%	10.00%
1DC	126	29.0	12.6	126.0	29.0	12.6	23.00%	10.00%
1DD	130.8	30.1	13.1	130.8	30.1	13.1	23.00%	10.00%
1EA	202	40.4	18.2	202.0	40.4	18.2	20.00%	9.00%
1EB	182.3	36.5	16.4	384.3	76.9	34.6	20.00%	9.00%
1EC	126.2	25.2	11.4	126.2	25.2	11.4	20.00%	9.00%
1ED	65.3	13.1	5.9	575.8	115.2	51.8	20.00%	9.00%
1EE	161.1	32.2	14.5	2712.9	471.9	236.1	20.00%	9.00%
1EF	92.3	18.5	8.3	3039.3	537.2	265.5	20.00%	9.00%
1EG	234.1	46.8	21.1	234.1	46.8	21.1	20.00%	9.00%
1FA	53.8	9.9	4.8	53.8	9.9	4.8	18.40%	9.00%
1FB	80.7	14.8	7.3	134.5	24.7	12.1	18.40%	9.00%
1FC	70.3	12.9	6.3	204.8	37.7	18.4	18.40%	9.00%
1FD	117.7	21.7	10.6	117.7	21.7	10.6	18.40%	9.00%
1FE	272.1	50.1	24.5	594.6	109.4	53.5	18.40%	9.00%
1FF	111.3	20.5	10.0	111.3	20.5	10.0	18.40%	9.00%
1FG	240.2	44.2	21.6	946.1	174.1	85.1	18.40%	9.00%
1GA	99.9	11.6	5.2	99.9	11.6	5.2	11.60%	5.20%
1GB	144.9	16.8	7.5	244.8	28.4	12.7	11.60%	5.20%
1GC	291.4	33.8	15.2	291.4	33.8	15.2	11.60%	5.20%
1GD	196	22.7	10.2	853.8	99.0	44.4	11.60%	5.20%
1GE	115.2	13.4	6.0	115.2	13.4	6.0	11.60%	5.20%
1GF	62.2	7.2	3.2	62.2	7.2	3.2	11.60%	5.20%
1GG	121.6	14.1	6.3	121.6	14.1	6.3	11.60%	5.20%
1HA	208.1	14.6	7.3	208.1	14.6	7.3	7.00%	3.50%
1HB	178.3	12.5	6.2	178.3	12.5	6.2	7.00%	3.50%
1HC	124.7	8.7	4.4	124.7	8.7	4.4	7.00%	3.50%
1HD	191.1	13.4	6.7	191.1	13.4	6.7	7.00%	3.50%
1HE	224.3	15.7	7.9	224.3	15.7	7.9	7.00%	3.50%
1HF	196.7	13.8	6.9	196.7	13.8	6.9	7.00%	3.50%
1JA	305.6	28.7	11.9	305.6	28.7	11.9	9.40%	3.90%
1JB	105.7	9.9	4.1	105.7	9.9	4.1	9.40%	3.90%
1JC	161.4	15.2	6.3	161.4	15.2	6.3	9.40%	3.90%
1JD	77.7	7.3	3.0	650.4	61.1	25.4	9.40%	3.90%
1JE	151.2	14.2	5.9	151.2	14.2	5.9	9.40%	3.90%
1JF	325.5	30.6	12.7	476.7	44.8	18.6	9.40%	3.90%
1JG	94.5	8.9	3.7	1221.6	114.8	47.6	9.40%	3.90%
1KA	155	12.9	3.1	155.0	12.9	3.1	8.30%	2.00%
1KB	952.8	79.1	19.1	1840.6	104.4	26.6	8.30%	2.00%
1KC	732.8	12.5	4.4	732.8	12.5	4.4	1.70%	0.60%
1LA	543.3	9.2	3.3	543.3	9.2	3.3	1.70%	0.60%
1LB	341.9	5.8	2.1	341.9	5.8	2.1	1.70%	0.60%

Sources: Annual mean flows were taken from NWMP(1980) and low flows were estimated by the study team based on monthly flow data (see text).

Table 7.12 Past Performance and Problems of Water Development (1/3)

District	Water Supply		Water Resources		
	Past Performance	Problems	Potential	Problems	Needs
KISUMU	. 8 water supply run by MOWD . 18 self help projects which are various stage of implementation	. insufficient well-trained technical staff to ensure validity of project proposals	. rainfall: 1200 - 1600mm/year . Nyando R., Sondu/Miriu R., hydropower generation, large scale irrigation, fishery	. floods of Kano Plain cause water-borne diseases, production losses and sediment flows into Lake Victoria; Nyando R. is polluted a little by sugar factories	. Catchment conservation, flood control, land reclamation and drainage, water supply schemes, effluent monitoring and pollution control
SOUTH NYANZA	. 1979/83 implementation rate MOWD funded w/s: 50% self-help w/s: 15% Homa Bay sewage 50% . existing water facilities . 110 earth dams 36 hand dug wells 32 water supply schemes . 36 functioning boreholes	. inadequate fund and design . None of w/s schemes are functioning at desirable standard. . lack of diesel, parts and maintenance in w/s . over utilization where demands exceed supply . only 4% of district population has access to clean water	. rainfall: 1000-1600mm/year . Kuja R., Sondu. R, Awach R., and Lake Victoria . large and small scale irrigation . hydro electric generation	. many dams are silted . many wells are polluted, Migori R. is infected by cholera	. All w/s require rehabilitation and augmentation
KISII	. wells, springs, boreholes are well distributed . 1979/83 implementation rate for piped water supply is 25% . existing w/s facilities 11 w/s by MOWD 13 w/s by Ministry of Health 5 w/s by various institutions . rate of utilization of operational w/s is 75 to 90% . 13 functioning boreholes	. limited capacity of MOWD to carry surveys and designs of approved w/s projects . limited budget for recurrent and development funds . mechanical breakdown, lack of supplies (diesel)	. rainfall: 1600-2000mm/year . Kuja R., groundwater yields are high.	. only Kisii Township has a sewage disposal system; effluent discharge from coffee and tea factories.	. irrigation in the lower zones of Ogembo and Bosongo Divisions . sewage systems for Keroka, Nyamira, Manga, Ogembo, and Suneka . pollution control for factory effluent. . swamp drainage work . Kisii Valley Bottoms Development Project . piped w/s
SIAYA	. 1979/83 performance: only partial success . existing w/s 4 urban w/s by MOWD 5 rural w/s 13 w/s by Ministry of Health or county council . grant from EEC and CARE/Kenya . 20 functioning boreholes	. lack of technical staff in MOWD . inadequate development fund.	. rainfall: 900-2000mm/year . Yala R., Nzoia R., Lake Victoria . large scale irrigation in Yala swamp.	. flood in Yala Swamp.	. Yala swamp drainage and reclamation . drinking water . soil conservation

Table 7.12 Past Performance and Problems of Water Development (2/3)

District	Water Supply		Water Resources		
	Performance	Problems	Potential	Problems	Needs
KAKAMEGA	. 1979/83 performance of MOWD overall implementation rate is 33% no-construction of sewage systems implementation of 10 self-help w/s . existing w/s facilities 11 w/s by MOWD 1 w/s by Ministry of Agriculture 1 w/s by Kakamega County Council 3 w/s by Ministry of Health . KEFINCO Water Supply Program . 224 hand dug wells, 103 bore-holes and 122 protected springs	. financial constraints . 3 w/s by MOWD are overutilized and need augmentation and extension . breakdown of pumping units and bursts of rising mains . demand is higher than production and results in water-shortage.	. rainfall: 1200-2000mm/year . Yala R., and tributaries of Nzoia R.	. Nzoia R. is polluted at the down-stream of Webuye and Mumias.	. large scale w/s projects rather than many small scale w/s project . spring water protection . water well protection . watershed management of Edzawa R
BUNGOMA	. existing w/s facilities 3 urban w/s; 4 rural w/s; 1 institutional w/s . utilization level is 90% for rural w/s, 100% for urban w/s . KEFINCO Water Supply program	. require rehabilitation. . lack of technical staff . shortage of fund	. rainfall : 1200 - 1800mm/year . Teremi R., Nzoia R., have hydro-power potential	. high population growth rate . deforestation and soil erosion by settlement . water borne diseases	. rehabilitation and extension of existing w/s and construction of new w/s . construction of sewage disposal system . to urge the Government to halt settlement in the water catchment
BUSIA	. 1979/83 MOWD project implementation of w/s, flood protection, minor irrigation was 25% . existing w/s projects are 28 2 urban w/s; 7 rural w/s; 2 institutional w/s; 2 self-help; 5 on-going projects . borehole water project by KEFINCO	. Lack of design and financial limitation . lack of supply of diesel	. rainfall : 1000 - 2000mm/year . Sio R., and Nzoia R. but fluctuations in Sio R. flows are high .	. frequent cholera outbreaks . 10,000 people affected by floods from Nzoia and Yala Rivers every year in Bunyala location; people are displaced and lose crops and houses.	. expansion and extension of w/s to meet the demands . provision of clean drinking water . flood protection works and flood relief assistance . swamp drainage and reclamation . minor irrigation programmes . sewage system
TRANS-NZOIA	. 1979/83 overall water sector project implementation rate was 67%, where: Rural water supply IV 0% Water Betterment Prog. 57% Kitale Municipal 100% . 16 w/s projects are existing	. late release of project fund . reluctance of the people to participate fully in construction for projects . inadequate technical personnel . inadequate reccurent fund and transport.	. rainfall : 1000-1400mm/year . tributaries of Nzoia R., water is recharged at Mt. Elgon slopes and Cherangani Hills;; . 57 dams are existing, constructed by the Soil Conservation Service and the former settlers	. many dams are silted and only 18 dams are operating . rather dry as compared to other districts . water pollution by chemicals for fertilizer.	. irrigation, flood control, exploitation of hydro-electric potential, water bodies for fish breeding, storage for water supply , dam rehabilitation, soil and water conservation, river bank protection, dam construction and groundwater in the Northern part.
UASIN GISHU	. 1979/83 overall project implementation rate is 56% where Rural Water supply III & IV 60% minor urban center 33% self - help 62%	. lack of fund . lack of proper design and costing for self-help projects . insufficient capacity and resources of the Survey and Design Department of MOWD	. rainfall : 1000-1400mm/year . tributaries of Nzoia R. but not many flowing rivers in all seasons	. the district is rather dry as compared to other districts . groundwater potential is not high . dams are silted	. investigation of groundwater potential . dam rehabilitation . construction of big dams

Table 7.12 Past Performance and Problems of Water Development (3/3)

District	Water Supply		Water Resources		
	Performance	Problems	Potential	Problems	Needs
NANDI	. 1979/83 overall project implementation rate is 50% . existing w/s facilities 2 urban w/s and 2 rural w/s by MOWD 24 w/s by county councils . over 30 self-help water projects	. over utilization due to population increase . most of county councils w/s are not operational due to lack of supervision, fund and community involvement . slow implementation of self-help projects	. rainfall :1400 - 2000mm/year . tributaries of Yala R. and Nzoia R.	. long walking distance for dairy cattles to drink water reduces the amount of milk production.	. more piped water in service centers and homesteads.
KERICHO	. 1979/83 overall project implementation rate is 38% . 29 w/s facilities are existing of which 45% is incomplete, 10% is functioning inadequately, 21% is full utilized, 24% is over utilized	. funds were not provided by the Government . projects were proposed too late to DDC . breakage of pumping machines . revenue collection is not efficient	. rainfall : 1200 - 2000mm/year . Nyando R., Awach R., and Sondu R.		. rehabilitation and development the waste water disposal facilities in Urban centers . to increase the population served water in rural areas . to complete construction and expansion of already started rural w/s. . construction of small earth dams for w/s.
NAKURU	. 1979/83 overall project implementation rate is 57% . existing w/s facilities	. inadequate design . no fund released . project proposals were not followed up . inadequate personnel for implementation . insufficient recurrent cost for w/s facilities run by local communities . over utilization due to population increase.	. rainfall : . poor water resources potential; poor groundwater potential.	. deep well is needed to reach ground-water, which is expensive . many dams constructed long time ago are silted.	. construction of dams at the small and seasonal rivers . educate people to protect water catchment . desilting of dams . augumentation and expansion of w/s systems
NAROK	. 1979/83 overall project implementation rate is 75% . existing w/s projects are 22	. all w/s projects are small . many of w/s facilities are incomplete, non-operational, or under construction	. rainfall : 1200 - 1600mm/year . migori R. and Mara R. . water availability is poor, especially in the range areas, i.e., Loita plains and the eastern part; northern and western parts of the district have good water potential; Maji Moto and Uaso-Nyiro areas have good groundwater potential	. flow fluctuations of Migori R. is high.	. investigation of groundwater in Morij-Loita, Narosura-Aitong and Maara areas . dam construction . sewage in Narok Township.

Sources: District Development Plan 1984-1988 for all the districts in the Lake basin; District Water Engineers; Questionnaire to each district

Table 7.13 Piped Water Supply under Operation (1/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase / Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
KISUMU DISTRICT											
MUHORONI	Muhoroni	R.Nyando	118	-	45	-	-	-		-	-
URBAN	Township	Full	-	-	43	-	105	-		-	
MOWD				94			44			-	
NYABONGO	Sondu Township	R. Miriu	210	-	94	-	-	-		-	-
RURAL	Nyadondo Compx.	Full	-	-	91	-	33	-		-	
MOWD	Sigoti Centre			143			194			-	
MUSENO	Museno Division	Maragoli	-	3500	-	-	-	-		-	-
RURAL	KOMBEWA	Brooks	-	-	-	-	-	-		-	
MOWD		Full		182			-			-	
NYAHERA	Ogoda Sec. Sch., Health Ctr.	Spring	110	-	37	-	-	-		-	-
RURAL	Primary Sch. & Entire	Chl.	-	-	34	-	-	-		-	
MOWD	Community			88			-			-	
TAMU	Tamu Township	Borehole	14	-	6	-	-	-		-	-
URBAN		Chl.	-	-	6	-	-	-		-	
MOWD				22			-			-	
MKWENDWA	Riat and	Spring	350	19600	-	-	-	-		-	-
RURAL	Mkwendwa	Chl.	-	20	-	-	-	-		-	
MOWD	KANYAKWAR			38			-			-	
KIBIGORI	Kibigori	R. Kibomet	195	14600	-	-	-	-		-	-
URBAN	Township	Chl.	-	14.6	-	-	-	-		-	
MOWD				142			-			-	
AWASI	Nyangoma Mission	Borehole	36	-	24	-	-	-		-	-
RURAL	Awasi Sec.Sch.	Chl.	-	-	19	-	-	-		-	
MOWD	Awasi Trading Ctr.			28			-			-	
KORU-MNARA	Mnara	Stream Tri.	250	5000	-	-	-	-		-	-
RURAL	Villagers	of R.Nyando	-	-	-	-	-	-		-	
MOWD		Full		-			-			-	
NEW PRISON	Kodiaga	L. Victoria	-	-	-	-	-	-		-	-
INST.	Prison	Full	-	-	-	-	-	-		-	
M. OF HOME AF				-			-			-	
AHERO	Mission Sec.	Borehole	-	-	-	-	-	-		-	-
INST.	School		-	-	-	-	-	-		-	
MISSION							-			-	
CHULAIMBO	Chulaimbo Sec.	Borehole	-	-	-	-	-	-		-	-
INST.	School		-	-	-	-	-	-		-	
M. OF HEALTH							-			-	
THURGEM	Thurgem Sec.	R. Awach	-	2600	-	-	-	-		-	-
RURAL	School	No	-	4.5	-	-	-	-		-	
SELF HELP/DDC							-			-	

Table 7.13 Piped Water Supply under Operation (2/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity: Act. production (m3/d)	Served population: Served area(km2) / No. of connection	Production: Accounted-for (1000m3/y)	Domestic use(%): Consumption (l/cap/d)	Tariff(Kshs/m3): Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase: Expansion (%)	Expansion cost (1000 Kshs.): Capacity(m3/d) / Population	Present source sufficient?
WITHUR	School	Borehole	-	-	-	-	-	-		-	-
RURAL		No	-	-	-	-	-	-		-	
KISII DISTRICT											
NEW KISII	Urban	R. Kuja	4000	30000	-	90	1.1	Urban		-	-
URBAN		Full	4000	29	-	250	1584	30000		-	
MOWD/1976				-			1224			-	
NYAMIRA	Urban	River	200	6800	-	95	2.65	Urban		-	-
URBAN		Full	400	96	-	60	229	6800		-	
MOWD/1978				-			318			-	
KEROKA	Urban	River	244	5000	-	95	2.65	Urban		-	-
URBAN		Full	143	30	-	150	179	5000		-	
MOWD/1976							633			-	
SAMETA	Rural	R. Kuja	400	10000	-	90	2.65	Rural		-	
RURAL		Full	300	50	-	60	237	300		-	
MOWD/1976							793			-	
MANGA	Rural	Spring	25	1800	-	100	2.65	Rural	10	650	Yes
RURAL		No	30	13	-	60	30	300		150	
MOWD/1976							94			3000	
GESUSU	Rural	Spring	6	6000	-	95	2.65	Rural	10	800	Yes
RURAL		No	15	9	-	60	5	15		150	
MOWD/1976							144			3000	
TOMBE	Rural	Spring	23	1800	-	95	2.65	Rural	10	540	Yes
RURAL		No	30	20	-	60	25	30		150	
MOWD							129			3000	
SIAYA DISTRICT											
SIAYA	Siaya Town	Abura dam	900	9000	300	-	2	-		-	-
URBAN		Full	900	7	292	-	588	-		-	
MOWD				735			561			-	
BONDO	Bondo Urban	R. Yala	480	4000	91	-	2	-		-	-
URBAN	Centre	Full	360	5	90.2	-	254	-		-	
MOWD				170			307			-	
YALA	Yala Urban	R. Yala	-	-	76.5	-	2	-		-	-
URBAN	Centre	Full	-	-	75	-	181	-		-	
MOWD				-			150			-	
UKWALA	Ukwala Urban	Borehole	136	500	14.4	-	2	-		-	-
URBAN	Centre	Chl.	52	106	14.2	-	45	-		-	
MOWD							55			-	
UYOMA	Uyoma	L. Victoria	1100	10000	45	-	-	-		-	-
RURAL	Asembo	Filt & Chl.	216		44.1	-	250	-		-	
MOWD							221			-	

Table 7.13 Piped Water Supply under Operation (3/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
SIDINDI	Yala Town Urban and	R. Yala	9135	16000	326	-	-	-		-	-
RURAL	Rural Centres	Full	1900	-	302	-	-	-		-	
MOWD	MALANGA			630			-			-	
MAUMA	Rural Areas	Dam	225	200	14	-	-	-		-	-
RURAL		Chl.	60	-	13.8	-	16	-		-	
MOWD				49			79			-	
ALUOR	Rural Areas	Small Stream	45	200	11	-	-	-		-	-
RURAL		No	45	-	10.8	-	9	-		-	
MOWD				49			23			-	
URANGA	Rural	Borehole	45	100	1.4	-	-	-		-	-
RURAL		No	2	-	0.67	-	-	-		-	
MOWD				2			-			-	
KAKAMEGA DISTRICT											
KAKAMEGA	Kakamega	R. Ishiukhu	2313	15000	880.3	97.1	2	-	11.3	-	Yes
URBAN		Full	2412	-	855	40.3	1638				
				2037			962				
MASENO	Maseno Complex	R. Edzawa	855	-	134.8	95	2		11.7	-	Yes
URBAN	Luanda Township	Full	369	-	-	5	251				
	Kima Mission			610			153				
KAIMOSI	Kaimosi Complex	R. Garagoli	403	10000	201	81.2	2	-	49.4	-	Yes
URBAN	North Maragoli	Full	551	-	146	29.9	371				
	Location			406			225				
MUMIAS	Mumias Sugar Co.	R. Lusumu	1113	10000	625.7	96	2	-	24.7	-	Yes
URBAN	Catholic Mission	Full	1714	-	331	87	666				
	Clx, Mumias Town			350			377				
BUTERE	Butere Girls & Boys	Two	43	-	68.5	96.7	2	-	7.2	-	No
URBAN	Sec. Sch. Butere Town	boreholes	188	138	66	42.9	136				
		Chl.					29				
VIHIGA	Majengo Township	Spring near	308	3000	49	98	2	-	2.6	-	No
URBAN	Vihiga Health C., Sec.	R. Edzawa	134	-	47	13.9	102		-		
	Sch.	Chl.		159			35				
KIBOSWA	Kiboswa & Gambogi	Spring	391	7000	113.4	95.6	2	-	18.4	-	Yes
URBAN	Mkts. Nyangori Sec.	Chl.	311	-	109	44	253				
	Sch.			271			182				
SHITOLI	Mukumu Complex	R. Yala	845	38000	308.5	82	2.65	-	67.8	-	Yes
RURAL	Khayega Mkt.	Full	-	824	261	29.5	460				
	Bukura F.T.C						385				
MBALE	Mbale Mkt. Mbale	R. Edzawa	709	25000	363.7	96.4	2.65	-	11.8	-	Yes
RURAL	Rural Health C.Cha-	Full	996	1117	333	26.5	878				
	vakali Sch.Eregi T.T.C.						561				

Table 7.13 Piped Water Supply under Operation (4/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
LUMAKANDA	Lumakanda's Ad-	R. Fuvuam-	49	1000	3.2	96.3	2.65	-	1	-	Yes
RURAL	ministrative Centre	biro Chl.	9	45	3	4	13				
							12				
HAMISI	Hamisi Trading C.	Spring	9	1000	4	96	2.65	-	1	-	Yes
RURAL	D.O. 's Office	Chl.	10	42	3.5	7.4	12				
							8				
MALAVA	Malava Schs. D.O.'s	Spring	43	2000	13	96.4	2.65	-	32.5	-	No
RURAL	Offices Mak.	Chl.	36	100	12	8.2	33				
	Police Lines						29				
SHIKUSA	Shikusa Prison	Boleholes	16	-	5.8	-	-	-	-	-	-
INST.	Bostal Correctional	by Kefinco	-		4	-	-				
	Centre	Chl.					-				
BUKURA	Bukura Agricultural	Dam	71	8400	26	-	-	-	-	-	-
INST.	Institute	Full	-		23						
BUNGOMA DISTRICT											
BUNGOMA	Bungoma	R.Kuywa	1500	25000	588	98	2	32000		1310	Yes
URBAN	Town	Full	1611	12	432	75	479			1800	
MOWD				26			840			-	
WEBUYE	Webuye Town	R.Nzoia	1200	25000	373	96	2	23000		-	Yes
RUBAN	Pan paper	Full	1022	10	358	75	777			-	
MOWD	Factory			1560			800			-	
KIMILILI	Kimilili Area	R. Kimilili	2200	12000	56	98	2	15000		-	-
URBAN		Full	154	10	55	50	126			-	
MOWD				292			123			-	
NDIVISI	Ndivisi	R. Kimilili	2000	43000	642	90	-	102000		-	Yes
RURAL	Makuselwa	Full	1759	84	626	30	1948			-	
MOWD				683			600			-	
KIBICHORI	Kipkateny ,Chwele,	R. Kuywa	1500	53000	357	90	-	49000		-	Yes
RURAL	Chebukaka,Mabanga,	Full	978	120	341	30	289			-	
MOWD	Bokoli, BOKOLI			379			360			-	
KIBICHORI	Kibichori	R. Kuywa	-	16000	111	96	-	29000		2400	Yes
RURAL		Sedimentation	304	40	106	30	97			-	
MOWD							276			-	
CHESIKAKI	Chesikaki	R. Malakisi	1900	84000	678	95	-	61000		-	Yes
RURAL	Sirisia	Full	1857	138	609	30	924			-	
MOWD	Malakisi			919			480			-	
AMAGORO	Amagoro	Spring	-	1000	3.55	100	-	-		-	No
RURAL	Divisional	Chl.	12	0.5	3.4	30	0.721			-	
MOWD	HQs.			20			120			-	

Table 7.13 Piped Water Supply under Operation (5/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
MALABA	Police, Post,	Borehole	-	1000	-	100	-	-		-	No
INST.	Immigration	No	14	0.5	-	30	60			-	
MOWD	Customs			-						-	
BUSIA DISTRICT											
BUSIA/MUNDI	Busia Town	R. Sio	1500	25000	318	97.75	2	33900		8059	1100
URBAN	Alupe Hospital	Full	885	192	311	-	309			33000	
MOWD/1980	Chakol G.S. Sch			667			1059			-	
NAMBALE	Nambale Health C.,DO'	Bolehole	-	-	5	94.7	2	-	-	-	50
URBAN	Office,Nambale Mkt.	No.c. 2020	50	46	5		19			-	
MOWD/1956		Chl.		-	-		81			-	
BUSIA HILLS	Hakati Area	L. Victoria	-	2000	19	97	flat rate	-	-	-	120
RURAL	Budalangi Sec.	Chl.	44	100	15	-	15			-	
MOWD/1973	School			72			140				
PORT VICTORIA	Port Victoria	L. Victoria	-	1750	26	99	flat rate	-	-	-	150
RURAL	Hospital, Mkt. C.	Chl.	72	30	25	-	31				
MOWD/1978	John O. Sec. School			65			198				
BUJUMBA	Bujumba Sub-	Spring	15	-	5	94.6	flat rate	-	-	-	50
RURAL	Location. The	No	-	1.5	5	-	10				
MOWD/1979	Sec. Sch.			38			63				
SIO PORT	Sio Port trading	L. Victoria	-	868	12	96.9	flat rate	-	-	-	120
RURAL	C. Police stn.	Chl.	19	2	11	-	20			-	
MOWD/1969	Health center			24			92			-	
FUNYULA	Funyula C. & Nangina	Spring	-	700	5	96.65	flat rate	-	-	-	90
RURAL	NANGINA	Chl.	14	2.5	4	-	20			-	
MOWD/1964				31			67			-	
MUNANA	Sigalame	Dam or	-	710	18	98.5	flat rate	-	-	-	90
RURAL	High School	Wakhungu	49	6	18	-	6			-	
MOWD/1966		Chl.		13			83			-	
WAKHUNGU	Nangina School	R. Wakuhung	-	2200	21	94.7	flat rate	-	-	-	150
RURUAL	Hospital	Chl.	65	16	20	-	3			-	
MOWD/1961	Neighbourhood			14			72			-	
BUTULA	Butula C. Sch.	Borehole	-	1750	-	-	flat rate	-	-	-	70
RURAL	Neighbourhood	No	170	-	-		-			-	
MOWD/1985				96			-			-	
TRANS NZOIA DISTRICT											
KWANZA	Centre Kwanza	Ngenge dam	270	700	7.2	60	2.4	-	5	-	Yes
RURAL	KOLONGOLO PHASE I	No	25	6	6.84	3.6	9			372	
MOWD				38			54			10500	
SABOTI	SABOTI	Spring	60	3500		90	flat rate	-	-	-	No
RURAL		Chl.	No master meter	4		10	15			-	
MOWD			to gauge	13			1.34/78			-	

Table 7.13 Piped Water Supply under Operation (6/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity: Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production: Accounted-for (1000m3/y)	Domestic use(%): Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
KITALE	Kitale	R. Kwotobos		32000	-	-	-	-	-	-	-
URBAN	Municipality	Full	2170	85	-	-	-			-	
K.MUN./1931							-			-	
NZOIA URBAN	Kitale	R.Nzoia		55000							
KITALE MUN.	Municipality	Full		85							
1986											
SUWERWA	Suwerwa Shopping	R. Suwerwa			-	-	-	-	-	-	-
RURAL	Centre	No		0.08	-	-	-			-	
M. OF HEALTH							-			-	
SIBANGA	County Council	Sibanga			-	-	-	-	-	-	-
RURAL		No		0.06	-	-	-			-	
C. COUNCIL							-			-	
ENDEBESS	Endebess	R. Sabwani			-	-	-	-	-	-	-
RURAL	Shopping			0.06	-	-	-			-	
C. COUNCIL	Centre									-	
CHEPCHOINA	Chepchoina Shopping			0.06	-	-		-	-	-	-
RURAL	Centre	No			-	-					
C.COUNCIL											
KERICHO DISTRICT											
SOTIC	Urban	R. Kipsondi	204	4000	74	-	2	-		-	Yes
URBAN		Full		10	-	-	-	-		-	
MOWD				266			-				
KAPKATET	Urban	Swom Bore-	19	2500	-	-	2	-		-	Yes
URBAN		hole		5	29	-	-	-		-	
MOWD		Full		84			-				
LONDIANI	Urban	R. Masaito	-	3500	-	-	2	-		-	Yes
URBAN		Full	123	10	44	-	-			-	
MOWD				205			-				
KIPKELION	Urban	R. Kipvhorio	-	3700	38	-	2	-		-	Yes
URBAN		Full	115	7	-	-	-			-	
MOWD				112			-				
BOMET	Urban	R. Nyangorosi	-	2500	-	-	2	-		-	Yes
URBAN		Full	75	5	5	-	-			-	
MOWD				81			-				
LITEIN	Rural	R. Itare	-	150000	441	-	flat rate	-		-	Yes
RURAL		Full	1209	475	-	-				-	
MOWD/1985				-							
CHEPALUNGU	Rural	R. Nyangorosi	-	39000	93	-	flat rate	-		-	Yes
RURAL		No	96	410	-	-				-	
MOWD/1975				101							

Table 7.13 Piped Water Supply under Operation (7/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase / Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
LONGISA	Rural	Itibo	-	1500	7	-	flat rate	-		-	Yes
RURAL		Stream	32	10	-	-				-	
MOWD		No		33							
SIGOWET	Rural	Kipsanoi	-	600	-	-	-	-		-	Yes
RURAL		Spring	40	2	-	-	-			-	
MOWD/1986		Chl.		-			-				
KAPSOIT	Rural	Stream	-	2000	-	-	-	-		-	No
RURAL		No	60	10	-	-	-			-	
MOWD				-			-				
KABIANGA	Rural	R. Cheboseron	-	-	-	-	-	-		-	Yes
RURAL		Full	-	-	-	-	-			-	
MOWD				-			-				
SOSIOT	Rural	R. Cheboseron	-	-	-	-	-	-		-	Yes
RURAL		No	-	-	-	-	-			-	
C.C.KERICHO				-			-				
NAROK DISTRICT											
LEMEK	Lemek Town &	Spring	18	2500	4941	100	2	3000	20		No
RURAL	Surrounding	No	25	25	4205	6	10			50	
MOWD/1973	Area			14			33			3500	
OLOKURTO	Olokurto Town	River	60	1500	8456	100	15	2000	25		Yes
RURAL	& Surrounding	No	25	16	8456	16	1			50	
MOWD/1974	Area			21			28			2500	
MORIJO LOITA	Morijo Loita	River	12	1000	2376	100	2	15000	20		No
RURAL	Rural Centre	No	6.6	8	2376	7	1			2000	
MOWD/1973				7			6				
MULOT	Mulot Rural	River	80	2000	-	100	-	2500	25		Yes
RURAL		No	40	20	-	-	-				
MOWD/1982				2			-			3000	
KILGORIS	Kilgoris Town	River	250	5000	40039	100	2	10000	25		Yes
URBAN	& Surrounding	Full	120	30	20488	22	48				
MOWD/1984	Area			110			117			15000	
ANGARA/BAR	Angata Baragoi	River	23	1500	3626	100	15	2000	25	-	No
AGOI RURAL	Rural Centre	Chl.	12	10	3626	7	1			2500	
MOWD/1973				9			13				
NKARARU	Nkararu Rural	Spring	45	1500	2376	100	flat rate	2500	25	-	Yes
RURAL	Centre	Nkarumi	6.6	15	2376	5	15				
MOWD/1982		No		9			0.54				
LOLGORIEN	Lorgorien	Spring	12	2500	0.636	100	flat rate	3000	20		No
RURAL	Centre	No	12	16	0.636	3	0.79				
MOWD/1973				16			1			3500	

Table 7.13 Piped Water Supply under Operation (8/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
ELGEYO MARAKWET DISTRICT											
ITEN	Urban Areas	Kiptabus	360	4000	117	100	2	5000	-	1500	Yes
	Iten town	Boreholes	320	25	111	80	222				
MOWD/1972		Chl.					183			5000	
CHEPKORIO	Rural Areas	Kipkoin	240	2000	66	100	1.95	6000	-	580	Yes
	Chepkorio	Stream	180	-	63	90	12.3			6000	
MOWD/1980		Full		228			178				
TAMBACH	Urban Area	Tambach	80	850	26	100	2	2000	-	790	Yes
	Tambach	Spring	70	4	25	87	50			2000	
MOWD/1958		Chl.		66			73				
KAPTARAKWA	Rural Area	Kaptarakwa	960	1800	58	100	1.95	4000	20	780	Yes
	Kaptarakwa	Stream	160	64	55	88	107			4000	
MOWD/1983		Chl.		83			93				
CHEBIEMIT	Rural	Spring	120	400	7	100	1.95	900	10	900	Yes
	Chebiemit	Chl.	20	4	6	50	10			900	
MOWD				25			17				
NERKWO	Rural	R. Moiben	140	300	8	100	1.95	1500	3	1000	Yes
	Nerkwo	Chl.	23	4	2.6	46	13			1500	
MOWD/1972				17			13				
CHEBILBAI	Rural	Spring	36	300	6	100	1.95	900	4	1500	No
	Chebilbai	Chl.	18	6	5	60	10			-	
MOWD				15			13				
CHEPSIGOT	Rural	R.Tarako	824	2000	282	60	-	-	-	-	
CHEPTEMBO		Full	800	25	served free in	100	-			-	
MOWD				20	Kerio valley		10				
TOT	Rural Area	R. Ebubut	600	1500	54	60	-	-	-	-	
	TOT	Chl.	150	16	free water	100	-			-	
MOWD				18	Kerio valley		5				
CHESATEN	Rural	Mogil	600	500	54	60	-	-	-	-	
	Chesaten	Stream	150	8	free water	100	-			-	
MOWD		Chl.		23	Kerio valley		6				
KIPSOEN	Kipsoen	Spring	100	200	6	100	-	-	-	-	-
	Shopping Centre	No	18	-	5	60	-			-	
SELF HELP				5			6				
KILIMA	Kilima	R. Moiben	5	12	-	-	-	-	-	-	-
COUNTY		No	-	6	-	-	-			-	
COUNCIL											

Table 7.13 Piped Water Supply under Operation (9/9)

W/S name / Category / Agency	Name of served urban or rural	Water source / Treatment	Capacity / Act. production (m3/d)	Served population / Served area(km2) / No. of connection	Production / Accounted-for (1000m3/y)	Domestic use(%) / Consumption (l/cap/d)	Tariff(Kshs/m3) / Revenue / O & M cost (1000 Kshs./y.)	Total popul'n in the town (persons)	Ann increase Expansion (%)	Expansion cost (1000 Kshs.) / Capacity(m3/d) / Population	Present source sufficient?
WEST POKOT DISTRICT											
KAPENGURIA	Kapenguria	R. Kapenguria	724	5311	139	94	1.17	0.5311	24	-	Yes
URBAN	Town	Full	381	4	130	72	162			374.4	
MOWD/1980				298-M/72-F.R.			408			6325	
KARAS	Kapenguria	Tributory of	90	250	3	100	3.11	0.03	2	-	Not Known
URBAN	(Bendera)	R. Kapenguria	7.5	1	3	30	8			180	
MOWD/1980		Filt.		29-M/18-F.R.			46			500	
TARTAR KER-	Tartar/Keringeat	R. Kapenguria	136	4500	16	86	1.62	1000	1	-	Yes
INGET RURAL		Full	44	12	-	10	17			90	
MOWD/1977				57-M/15-F.R.			116			10000	

Table 7.14 Piped Water Supply Projects under Construction or Planning (1/3)

W/S name	Name of served area	Water source	Served population	Total cost (million Kshs.)	Present status % of completion
Category/Agency or Fund		Treatment	Served area (km2)	Capacity (m3/d)	Expected year of completion
KISUMU DISTRICT					
PAGA BEACH	Kisumu West	L. Victoria	15,122	-	50
RURAL/RDF		Simple Chl.	-	756	-
KORWENDE	Central Seme	R. Awach Seme	10,500	2.2	-
RURAL/EEC,RDF		Full	-	445	-
WEST SEMB	Maseno division	L. Victoria	33,900	-	80
RURAL/EEC,KFFHC,MOWD		Simple Chl.	-	1,794	Late 1987
NYAKACH	-	Full	-	-	-
RURAL/MOWD			-	-	-
KISII DISTRICT					
KIERENI	West Kitutu	R. Mugusii	66,403	30	15
RURAL/MOWD		Full	132.2	5,716	1990
BIRONGO	Irianyi &East Kitutu	R. Chirochiro	77,495	10	40
RURAL/KFFH & MOWD		Full	121	2,877	1989
RIOKINDO	Ogembo	R. Nyangweta	10,000	2.5	40
RURAL/RDF & MOWD		Full	18	700	1988
SENGERA	Ogembo	Spring	5,320	0.3	60
RURAL/RDF & MOWD		Raw	8	393.2	1988
NYAMBARIA	Manga	R. Kanyamware	6,700	2.85	50
RURAL/RDF & MOWD		Raw	5.8	2,422	1988
ETAGOSENGERA	Bosongo &Ogembo	R. Gucha &Nyan-	214,968	50	0
RURAL/MOWD		gweta Full	-	11,711	1992
RAMASHA NYANGUSO	Ogembo &	R. Gucha	294,410	50	0
RURAL/MOWD.	Irianyi	Full	-	17,221	1992
ETAGO	Bosongo	R.Umbati	15,315	2	0
RURAL/RDF/MOWD		Raw	-	784.56	1988
MATONGO IGONGA	Bosongo	R. Riana Tribu.	45,055	6	2
RURAL/MOWD		Raw	37	651	1990
SOTIK SETTLEMENT	Burabu	R.Kipsonoi	67,525	90	0
RURAL/MOWD		Full	298	9,736	1992
MANGA RURAL	Manga	R. Gucha	70,200	90	0
RURAL/MOWD		Full	117	4,324	1992
N. MUGIRANGO	Nyamira	R. Sondu	345,630	100	0
RURAL/MOWD		Full	689	41,507	1992
MOCHENWA	Manga	Mochenwa Spr.	4,000	0.6	0
RURAL/RDF		Raw	8.8	191.6	1987
GIONSERI	Ogembo	R. Nyamache Tr.	1,023	0.5	0
RURAL/RDF		Raw	1	37	1987
SIAYA DISTRICT					
S. SAKWA RURAL	South sakwa	L. Victoria	37,700	15	30
GDK NORAD, DOK	location	Full	158	1,860	1989
KARABOUR, RURAL	North Sakwa	R.Yala	38,225	-	30
GOK, RDF, NDRAD.	location	Full	140	808	-
YENGA SIRANGA RURAL	Yenga & Siranga	Ugenge Dam	27,000	-	80
GOK, EEC	Sub/location	Chl.	79	1,260	1989
URANGA SINAGA	Sinaga Centre & the	Stream	6,000	0.9	90
RURAL/RDF	neighbourhood	None.	10	462	1987
RAMULA URANGA RURAL	Ramula & Uranga	Stream	5,840	1.3	10
GDK, FKDF	Sub/location	None.	20	660	1988
USIGU USENGE	Isigu centre &	L. Victoria	31,890	8	0
RURAL GOK, FKDF	areas around	Chl.	145	-	-
SIDINDI/MALANGA PHASE		R. Yala	-	-	0
II Rural URBAN G.O.K.		Full	-	19,135	-
UGENYA UHOLO	Uholo	Spring /Bore	80,000	-	0
RURUAL/URBAN GOK	location	Hole or River	-	-	-

Table 7.14 Piped Water Supply Projects under Construction or Planning (2/3)

W/S name	Name of served area	Water source	Served population	Total cost (million Kshs.)	Present status % of completion
Category/Agency or Fund		Treatment	Served area (km2)	Capacity (m3/d)	Expected year of completion
KAKAMEGA DISTRICT					
CHAVANO MAHANGA	Vihiga division	-	14,500	1.2	on-going
SELF-HELP DDC		-	-	-	-
MALINDI/ZIRURO	Emuhaya	Edzawa	16,000	1.5	on-going
MOWD SELF-HELP			-	-	-
SOYI -	Lugari	R. Sengoit	10,000	4	on-going
DDC			-	-	1988-89
MAGUI/BUKOYANI	Vihiga	Spring	8,000	0.75	completed
SELF-HELP		-	-	-	-
EBUNANGWE	Emuhaya	Edzawa	8,600	0.4	on-going
- DDC			-	-	1986/87
LUMAKANDA	Lugari	R. Furambiro	2,000	0.29	on-going
- DDC			-	-	1986/87
LUGARI	Lugari division	Nzoia	25,000	0.80	Planning
- MOWD		Full	60	-	-
VIHIGA/HAMISI	Vihiga division	R. Yala	500,000	120	Planning
MOWD			-	-	-
CHEKALINI	Lugari division	-	47,000	3.3	planning
SELF-HELP			-	-	-
JEPROK	-	-	37,000	0.4	planning
SELF-HELP			-	-	-
EBUSIRATSI	Emuhaya division	-	30,000	-	-
			-	-	-
SISOKHE INSTITUTIONAL	-	-	-	-	completed
CARE-KENYA			-	-	-
MADIRA INSTITUTIONAL	-	-	-	100	completed
L.COMMUNITY			-	-	
BUNGOMA DISTRICT					
CHEMOGE/KAPSAKWONY	Mt. Elgon East	Dam	15,000	1.4	50
RURAL GOK/MOWD	location		50	270	1987
MACHWELE	North Mateka	Spring	6	3.5	50
RURAL RDF	location		6	112	1986(July)
MALABA/KOCHOLIA	N &S Teso-Busia	River	88,400	74	20
RURAL GOK/MOWD	West Bukusu Bungoma	Full	346	6,450	1989
BUNGOMA	East Buku &	River	135,000	91	0
RURAL	Bungoma	Full	280	7,540	-
BUSIA DISTRICT					
BUSIA-MUNDIKA	Busia Bugengi & .	R. Sio	33,000	8.06	75
URBAN GOK	Mundika Sub-loc.	Full	197km2	3200(1990)	1987
CHAKOL(REHAB)	Chakol H. School	Spring	700	0.1	98
INSTITUTIONAL RDF	in Busia	Nil	-	100	1986
OSIEKO	Obaro s/location	R. Sio	250	0.4	80
RURAL RDF	Bunyala	Full	2km2	15	1987
FUNYULA BUMALA	Marachi Bukhayo	R. Sio	33,000(1990)	20	90
RURAL GOK	Samia	Full	155 km2	1260(1990)	1986/87
MALABA-KOCHOLIA	Teso N &S West	R. Malakisi	83,870(1995)	70	21
RURAL/GOK	Bukusu (Bungoma)	Full	346km2	3376(1985)	1989
TRANS NZOIA DISTRICT					
KIMININI	Kiminini	R./Ewaso	11,000	-	-
RURAL/MOWD		Rongoi Full.	16	739	-
KIMONDO RURAL	Kimondo	R. Mubere	7,600	-	-
EEC,DDC/MOWD			45	800	-
KWANZA KOLONGOLO	Kolongolo	Asega Dam	10,500	-	-
PHASE II DDC, RDF,MOWD		Full.	47	642	-
MUNA	Chertangani	Stream	2,590	-	-
RURAL	Kapsara		7	8.9	-
NAIROBI	Cherangani	Stream	1,800	-	-
RURUAL			15	-	-
SIRENDE	Sirende	Stream	16,650	-	-
RURAL			37	-	-

Table 7.14 Piped Water Supply Projects under Construction or Planning (3/3)

W/S name	Name of served area	Water source	Served population	Total cost (million Kshs.)	Present status % of completion
Category/Agency or Fund		Treatment	Served area (km2)	Capacity (m3/d)	Expected year of completion
KERICHO DISTRICT					
KAPCHEROP	Kapcherop	River	3,000	23	0
RURAL/MOWD		Full.	28	20	2 years to construct
KIMNAI	Kimnai	Stream	700	1	0
RURAL SELF-HELP		Chl.	10	10	1.5 years
METKEITOOT	The whole of southern	Several	50,000	118	0
RURAL SELF-HELP	div. of Elegeyo Marakwet	Full.	-	-	7 years
SERGOIT	Sergoit	L. Sergoit	4,800	30	0
RURAL/MOWD		Full.	30	70	5 years
NAROK DISTRICT					
OLMASAIN	Muitanil	Dam	21,000	0.23	20
RURAL/MOWD			-	570	1986
TIMASHARIAN	Olopito Lamenet	Spring	6,000	2	75
RURAL/MOWD	Oletukuat Ilmasharian		-	846	1988
OLKINYEI	Olkinyei	B/Hole	400	0.11	75
RURAL/MOWD			-	200	1986
ENENGETIA	Mau West	River	5,000	0.37	68
RURAL/MOWD				240	1986
ENABELEBEL	Enaibelbel	R. Siapei	4,000	0.2	96
RURAL/MOWD			-	300	1988
N/ENKARE	Keekanyoke	Dam	13,000	6	22
RURAL/MOWD		Full	-	2700	1988
EMARTI RURAL	Emarti	R. Mara	4,000	0.13	95
DDC, MOWD, RDF			-	100	1986
NKARARU	Siria West	Nkararu	1,000	0.25	80
RURAL/GOK		Stream	-	200	1986
OLGILAI/RURAL	Olgilai area	R. Uaso	400	0.16	99
GOK, CARE KENYA		Nyiro	-	270	1986
MULOT	Mulot	R. Mara	4,650	1	90
URBAN/MOWD			-	265	1986
OLOLOLUNGA	Masandare and	R. Uaso	4,200	1.7	85
RURAL/EEC	Oloirieri	Nyiro	-	519	1986
RATIANY	Olerien and Ratiary	Dam	440	0.57	70
RURAL/RDF			-	69	1986
MOSIRO	Mosiko	River	-	0.05	20
RURAL/MOWD			-	-	1990
EWASO NYIRO	Ewaso Nyiro	River	-	0.05	0
RURAL/MOWD			-	-	1990
ELGEYO MARAKWET DISTRICT					
KAPSEGER	Kapseger area	R. Kipchororani	2,500	-	60
RURAL/MOWD			15	-	1988
MANARET RURAL	Munaret area	Dam	5,520	-	90
EEC/GOK		(reclaimed)	20	-	1988
CHEBANGANG	Chebangang area	Riptiget	8,000	-	90
RURAL/MOWD		Stream	45	-	1988
SIGOR/LONGISA	Sigor/Langisa area	R. Nyangorosi	150,000	-	60
RURAL/MOWD			551	-	-
FORT TERNAN	Fort teman area	Stream	2,000	-	45
RURAL/MOWD			32	345	-
CHEPKEMEL	Chepkemel area	Stream	5,000	-	90
RURAL/GOK			16	768	1988
WEST POKOT DISTRICT					
KAIBOS	kaibos/Kipkorinya	Two Springs	2,500	0.3	80
RURAL/SELF-HELP		None.	5	80	1987
TALAII	Keringet	Spring	800	0.1	90
RURAL/SELF-HELP	Sub-loc.	None.	4	40	1987
CHEPTUYA	Talau	R. Kapenguiria	4,500	3	10
RURAL/SELF-HELP		Full	15	660	1988
SIYOI	Siyoi	R. Paraywa	7,000	10	30
RURAL/GOK		None.	20	1728	1988
KANGILIKWAN	Kangilikwan	R. Kapenguria	500	0.04	10
RURAL/SELF-HELP		40 Full	2	40	1989

Table 7.15 Present Water Abstraction by Subbasin and Purpose

(unit:m3/day)

Subbasin	Domestic	Public	Industry	Min. Irr.	Gen.Irr.	Power	Other	Sub.B Total
1AA	53	13	91					157
1AB	217	91	295					603
1AC	0	0	91					91
1AD	238	27	0				2510	2775
1AE	11	1677	0					1688
1AF	68	9	0				91	168
1AG	0	76	0					76
1AH	3096	201	10				2447	5754
1A?	0	0	0				453	453
1BA	530	182	29	38		2447		3226
1BB	1450	2	283	13	23	2	22	1795
1BC	2029	16	373	18				2436
1BD	3996	282	1816	32			88	6214
1BE	7905	2795	2335	643	1613	2500	511	18302
1BG	2383	14	1958	13	23		105	4496
1BH	358	82	455				17	912
1B?	459	20	7					486
1CA	2604	0	170	27	13	1223	50	4087
1CB	8029	3590	901	17		726	150	13413
1CC	2335	0	223	9		26	46	2639
1CD	1591	0	141	9			275	2016
1CE	450	70	5			31	179	735
1C?	26	0	0					26
1DA	707	68	58	45			3689	4567
1DB	6796	81	4912	39				11828
1DC	0	63	91					154
1DD	172	133	2465	5			507	3282
1D?	22	0	0				7	29
1EA	245	688	11				9	953
1EB	1023	436	495	7	27	263	36	2287
1EC	29	41	48				20	138
1ED	437	1014	0	18			72	1538
1EE	157	235	0				54	446
1EF	15	1448	30				258	1751
1EG	314	14896	7					15217
1E?	3	0	0				27	30
1FA	716	0	18					734
1FB	2533	0	0			35		2568
1FC	3758	0	0	16			45	3819
1FD	3006	77	121	32	72	221	431	3960
1FE	4464	556	342			253	494	6109
1FF	8440	185	181				194	9000
1FG	1488	1991	2478				7335	13292
1F?	24	0	23				27	74
1GA	956	5	1430	29		1716	15	4151
1GB	1955	453	229	34	27		89	2787
1GC	2582	226	2291	27		31541	14120	50787
1GD	1685	164	7450	3			23	9325
1GE	418	0	0				11	429
1GF	0	0	0					0
1GG	55	0	36					91
1G?	109	0	0					109
1HA	1367	16291	4350	29	8		882	22927
1HB	22701	11	5982				4282	32976
1HC	274	1813	0					2087
1HD	226	4780	719				27	5752
1HE	338	152	182				2	674
1HF	0	21	91					112
1H?	2408	362	0					2770
1JA	306	0	0					306
1JB	1684	0	0				13	1697
1JC	1953	1228	193	4635	27	12	240	8288
1JD	81	0	91				27	199
1JE	223	0	0	15				238
1JF	2367	481	304		23	4893	113	8181
1JG	41	905	204					1150
1J?	18	0	0					18
1K	850	1347	1331	91		6792	75	10486

Source: Compiled from water abstraction data of Ministry of Water Development (see text).

Basin Summary

(unit:m3/day)

Basin	Domestic	Public	Industry	Min. Irr.	Gen.Irr.	Power	Other	Basin Total
1A	3683	2094	487	0	0	0	5501	11765
1B	19110	3393	7256	757	1659	4949	743	37867
1C	15035	3660	1440	62	13	2006	700	22916
1D	7697	345	7526	89	0	0	4203	19860
1E	2223	18755	531	25	27	263	476	22360
1F	24429	2809	3163	48	72	509	8526	39556
1G	7760	848	11436	93	27	33257	14258	67679
1H	27314	23430	11324	29	8	0	5193	67298
1J	6673	2614	792	4650	50	4905	393	20077
1K	850	1347	1331	91	0	6792	75	10486
Total	114774	59295	45346	5844	1856	52681	40068	319864

Table 7.16 Human and Livestock Population by Subbasin in 2005

Subbasin code	Human (1000 persons)			Livestock (1000 L.S. unit)	
	Urban	Rural	GW % of rural		GW %
1AA		108	90%	27	45%
1AB		107	90%	25	45%
1AC		39	90%	9	45%
1AD		123	90%	33	45%
1AE		59	90%	16	45%
1AF		167	90%	42	45%
1AG		168	90%	35	45%
1AH	91	257	90%	70	45%
1BA		90	60%	65	30%
1BB		139	60%	75	30%
1BC	10	150	60%	72	30%
1BD		237	60%	66	30%
1BE	121	372	60%	108	30%
1BG		310	60%	83	30%
1BH	8	203	60%	48	30%
1CA		143	60%	73	30%
1CB	237	129	60%	69	30%
1CC		126	60%	68	30%
1CD		151	60%	54	30%
1CE		102	60%	21	30%
1DA	66	264	60%	42	30%
1DB		283	60%	65	30%
1DC		156	60%	27	30%
1DD	118	167	60%	28	30%
1EA		292	90%	37	45%
1EB	136	199	90%	23	45%
1EC		144	90%	16	45%
1ED		84	90%	10	45%
1EE		200	90%	46	45%
1EF		165	90%	44	45%
1EG		281	90%	59	45%
1FA		46	90%	26	45%
1FB		115	90%	36	45%
1FC	11	90	90%	28	45%
1FD		150	90%	50	45%
1FE	22	347	90%	53	45%
1FF	60	172	90%	20	45%
1FG	27	450	90%	119	45%
1GA		104	70%	39	35%
1GB		174	70%	57	35%
1GC	30	208	70%	61	35%
1GD	20	178	70%	67	35%
1GE		94	70%	32	35%
1GF		63	70%	26	35%
1GG		105	70%	32	35%
1HA	715	284	60%	93	30%
1HB	13	279	40%	86	20%
1HC		402	30%	122	15%
1HD	8	421	60%	91	30%
1HE	21	440	50%	87	25%
1HF	32	318	30%	126	15%
1JA		161	60%	50	30%
1JB		60	60%	17	30%
1JC	108	82	60%	24	30%
1JD		53	60%	15	30%
1JE		279	60%	36	30%
1JF		313	60%	61	30%
1JG		190	60%	36	30%
1KA	130	345	80%	43	40%
1KB		1,898	60%	346	30%
1KC	27	463	60%	175	30%
1LA		242	50%	508	25%
1LB		187	50%	430	25%
Total	2,009	14,128		4,448	

Note: GW % is assumed by the Study Team, which is a groundwater dependent population.

Source: Projected by the Study Team.

Table 7.17 Water Demand by Subbasin by Purpose in 2005

	Surface water demand (Unit:MCM/year)							Groundwater demand (Unit:MCM/y)			
	Urb. W/S	Industry	Rur. W/S	Live S.	Irrigation	Total demand without irrigation	Total demand with irrigation	Domestic	Live .S	Total demand	Req.GW rech.mm
1AA	0.00	0.44	0.14	0.45		1.03	1.03	1.01	0.37	1.38	5.26
1AB	0.00	1.43	0.13	0.42		1.98	1.98	1.00	0.34	1.34	4.65
1AC	0.00	0.44	0.05	0.15		0.64	0.64	0.37	0.12	0.49	4.60
1AD	0.00		0.15	0.55		0.70	0.70	1.15	0.45	1.60	6.02
1AE	0.00		0.07	0.27		0.34	0.34	0.55	0.22	0.77	6.26
1AF	0.00		0.21	0.70		0.91	0.91	1.56	0.57	2.14	5.37
1AG	0.00		0.21	0.58		0.79	0.79	1.57	0.48	2.05	5.91
1AH	3.05	0.05	0.34	1.17		4.60	4.60	2.49	0.95	3.45	6.44
1BA	0.00	0.04	0.45	1.38		1.87	1.87	0.56	0.59	1.15	1.74
1BB	0.00	0.38	0.70	1.59		2.67	2.67	0.87	0.68	1.55	2.07
1BC	0.34	0.50	0.76	1.53	6.90	3.12	10.02	0.94	0.65	1.60	2.10
1BD	0.00	2.42	1.19	1.40	10.30	5.01	15.31	1.48	0.60	2.08	2.99
1BE	4.27	3.11	1.90	2.29	24.20	11.57	35.77	2.36	0.98	3.34	2.91
1BG	0.00	2.60	1.56	1.76	27.50	5.93	33.43	1.93	0.75	2.69	2.98
1BH	0.26	0.61	1.03	1.02		2.91	2.91	1.27	0.44	1.71	3.04
1CA	0.00	0.24	0.72	1.55		2.51	2.51	0.89	0.66	1.56	2.23
1CB	8.36	1.30	0.71	1.46		11.83	11.83	0.88	0.63	1.51	2.30
1CC	0.00	0.32	0.63	1.44		2.40	2.40	0.79	0.62	1.40	2.23
1CD	0.00	0.20	0.76	1.15		2.11	2.11	0.94	0.49	1.43	2.77
1CE	0.00	0.01	0.51	0.45		0.97	0.97	0.64	0.19	0.83	3.52
1DA	2.21	0.13	1.36	0.89		4.59	4.59	1.69	0.38	2.07	3.92
1DB	0.00	10.60	1.43	1.38		13.40	13.40	1.77	0.59	2.36	3.06
1DC	0.00	0.20	0.79	0.57		1.55	1.55	0.97	0.25	1.22	3.62
1DD	3.94	5.32	0.90	0.59		10.76	10.76	1.12	0.25	1.37	3.90
1EA	0.00	0.03	0.37	0.62		1.02	1.02	2.73	0.50	3.24	6.46
1EB	4.82	1.54	0.26	0.38		7.00	7.00	1.93	0.31	2.24	6.94
1EC	0.00	0.15	0.18	0.27		0.60	0.60	1.35	0.22	1.57	6.75
1ED	0.00		0.11	0.17		0.27	0.27	0.79	0.14	0.92	6.78
1EE	0.00		0.25	0.77		1.02	1.02	1.87	0.63	2.50	6.22
1EF	0.00	0.09	0.21	0.73	80.10	1.03	81.13	1.54	0.60	2.14	6.11
1EG	0.00	0.02	0.35	0.98		1.36	1.36	2.63	0.80	3.44	6.22
1FA	0.00	0.02	0.06	0.43		0.51	0.51	0.43	0.35	0.79	3.20
1FB	0.00		0.14	0.60		0.74	0.74	1.08	0.49	1.57	4.47
1FC	0.38		0.11	0.47		0.96	0.96	0.85	0.38	1.23	4.52
1FD	0.00	0.16	0.19	0.83		1.18	1.18	1.40	0.68	2.09	4.28
1FE	0.76	0.45	0.44	0.88		2.53	2.53	3.26	0.72	3.98	6.02
1FF	2.12	0.24	0.22	0.33		2.91	2.91	1.64	0.27	1.91	6.85
1FG	0.94	3.26	0.57	1.98	196.70	6.75	203.45	4.23	1.62	5.85	6.05
1GA	0.00	1.84	0.39	0.77		3.00	3.00	0.76	0.41	1.17	3.04
1GB	0.00	0.29	0.66	1.12	36.70	2.07	38.77	1.27	0.60	1.87	3.46
1GC	1.00	2.94	0.80	1.20		5.94	5.94	1.54	0.65	2.18	2.52
1GD	0.67	9.57	0.68	1.32	85.30	12.24	97.54	1.31	0.71	2.02	3.06
1GE	0.00		0.36	0.63	29.00	0.99	29.99	0.68	0.34	1.02	2.81
1GF	0.00		0.24	0.51	93.30	0.75	94.05	0.46	0.28	0.73	3.17
1GG	0.00	0.05	0.40	0.63		1.07	1.07	0.76	0.34	1.10	2.75
1HA	####	8.35	1.79	1.97	167.20	36.07	203.27	2.22	0.85	3.06	3.53
1HB	0.44	11.49	2.12	2.08		16.13	16.13	1.17	0.52	1.69	2.19
1HC	0.00		3.54	3.14		6.69	6.69	1.25	0.55	1.81	1.91
1HD	0.27	1.38	2.12	1.93	33.90	5.71	39.61	2.63	0.83	3.46	4.38
1HE	0.71	0.35	2.78	1.98	12.40	5.82	18.22	2.30	0.66	2.96	3.79
1HF	1.06	0.17	2.83	3.24		7.31	7.31	1.00	0.57	1.57	1.75
1IA	0.00		0.81	1.06		1.87	1.87	1.00	0.45	1.46	1.86
1IB	0.00		0.30	0.36		0.66	0.66	0.37	0.15	0.53	2.22
1IC	3.63	0.25	0.47	0.51		4.85	4.85	0.58	0.22	0.80	2.25
1ID	0.00	0.12	0.27	0.32		0.70	0.70	0.33	0.14	0.47	2.21
1IE	0.00		1.41	0.76		2.17	2.17	1.74	0.33	2.07	3.60
1IF	0.00	0.39	1.58	1.29		3.27	3.27	1.95	0.55	2.51	2.59
1IG	0.00	0.26	0.96	0.76	5.60	1.99	7.59	1.19	0.33	1.51	4.19
1KA	4.35	2.04	0.90	0.78		8.08	8.08	2.98	0.52	3.50	7.29
1KB	0.00		9.56	7.34	22.80	16.90	39.70	11.85	3.14	14.99	4.35
1KC	0.89		2.35	3.71		6.95	6.95	2.91	1.59	4.50	1.53
1LA	0.00		1.52	11.54		13.07	13.07	1.26	3.85	5.11	1.06
1LB	0.00		1.18	9.77		10.95	10.95	0.97	3.26	4.23	1.03

Source: Projected by the Study Team

Table 7.18 Water Utilization Ratio by Subbasin

	With irrigation			Without irrigation		
	Annual mean flow volume	Low flow (3-4 y.)	Low flow (30-40 y.)	Annual mean flow volume	Low flow (3-4 y.)	Low flow (30-40 y.)
1AA	2%	11%	22%	2%	11%	22%
1AB	3%	18%	35%	3%	18%	35%
1AC	3%	17%	34%	3%	17%	34%
1AD	0%	3%	6%	0%	3%	6%
1AE	1%	5%	10%	1%	5%	10%
1AF	1%	5%	10%	1%	5%	10%
1AG	1%	4%	8%	1%	4%	8%
1AH	1%	7%	15%	1%	7%	15%
1BA	3%	22%	33%	3%	22%	33%
1BB	2%	15%	24%	2%	15%	24%
1BC *	7%	47%	70%	2%	15%	22%
1BD *	3%	42%	79%	1%	8%	13%
1BE *	17%	105%	158%	5%	34%	51%
1BG *	19%	120%	179%	3%	21%	32%
1BH	2%	15%	22%	2%	15%	22%
1CA	3%	41%	108%	3%	41%	108%
1CB	10%	127%	332%	10%	127%	332%
1CC	2%	21%	55%	2%	21%	55%
1CD	1%	13%	43%	1%	13%	43%
1CE	0%	4%	22%	0%	4%	22%
1DA	0%	4%	13%	0%	3%	6%
1DB	6%	26%	61%	6%	26%	61%
1DC	1%	5%	12%	1%	5%	12%
1DD	8%	36%	82%	8%	36%	82%
1EA	1%	3%	6%	1%	3%	6%
1EB	2%	9%	21%	2%	9%	21%
1EC	0%	2%	5%	0%	2%	5%
1ED	0%	0%	1%	0%	0%	1%
1EE	0%	0%	1%	0%	0%	1%
1EF *	3%	21%	59%	0%	0%	1%
1EG	1%	3%	6%	1%	3%	6%
1FA	1%	5%	11%	1%	5%	11%
1FB	1%	3%	6%	1%	3%	6%
1FC	0%	3%	6%	0%	3%	6%
1FD	1%	5%	11%	1%	5%	11%
1FE	0%	2%	5%	0%	2%	5%
1FF	3%	14%	29%	3%	14%	29%
1FG *	22%	123%	267%	1%	4%	9%
1GA	3%	26%	58%	3%	26%	58%
1GB	16%	153%	398%	1%	8%	21%
1GC	2%	18%	39%	2%	18%	39%
1GD *	12%	153%	396%	1%	14%	38%
1GE *	26%	224%	501%	1%	7%	16%
1GF *	151%	1,303%	2,908%	1%	10%	23%
1GG	1%	8%	17%	1%	8%	17%
1HA *	98%	1,395%	2,791%	17%	248%	495%
1HB	9%	129%	259%	9%	129%	259%
1HC	5%	77%	153%	5%	77%	153%
1HD *	21%	296%	592%	3%	43%	85%
1HE *	8%	116%	232%	3%	37%	74%
1HF	4%	53%	106%	4%	53%	106%
1JA	1%	7%	16%	1%	7%	16%
1JB	1%	7%	16%	1%	7%	16%
1JC	3%	32%	77%	3%	32%	77%
1JD	0%	1%	4%	0%	1%	4%
1JE	1%	15%	37%	1%	15%	37%
1JF	1%	8%	20%	1%	8%	20%
1JG *	1%	7%	22%	0%	2%	6%
1KA	5%	63%	260%	5%	63%	260%
1KB *	2%	44%	208%	1%	19%	89%
1KC	1%	56%	158%	1%	56%	158%
1LA	2%	141%	401%	2%	141%	401%
1LB	3%	188%	534%	3%	188%	534%

Note: Zero % is a rounded value and not absolute zero.
Source: Computed by the Study Team.

Table 7.19 Rural and Urban Water Supply Programmes

Service area	Rural Areas							Urban Areas	
Source of Water	Ground Water			Surface Water				Surface Water	
Mode of Water Supply	Handpump Wells	Private Wells	Protected Springs	Piped W/S Rehab. Minor Expansion	Competion o On-going Piped W/S	Improved Traditional	Roof Catchment	Roof Catchment	Piped W/S Rehab. and Expansion
Served Area	Rural Market Centers	-	-	Service Centers	Service Centers	Rural	Rural	Peri-Urban	Urban
Estimated Present Population Coverage	n.a	n.a	n.a	5- 10%		n.a	n.a	n.a	30 - 40%
Target 2005		65%				35%		100%	
Population Coverage	50%	10%	5%	10 %		5%	20%	10%	90%
		9,568				5,152		1,980	
Population (x 1000)	7360	1,472	736	1,472		736	2,944	198	1,782
Unit Cost/Capita (Kshs)	300	individual	120	200		Unknown	Individual	Individual	700
Invest. Capital Required (Kshs)	2,208m	-	88m.	294m.	500m.	-	-	-	1,247m

Table 7.20 Kisumu Municipal Water Supply Expansion Plan

Year	1986	1987-1988	1989-1995	1996-2005
Served Population	125,000		218,000	356,000
Step or Stage of Work	Emergency Step I rehabilitation	Immediate works Step 2 minor expansion	Stage I Step 3 major expansion	Stage II major expansion
Supply	15,100m^3/day	20,000m^3/day (1988 demand)	41,000m^3/day (1995 demand)	62,000m^3/day (2005 demand)
Source of Water	Lake water	Lake water	Lake water	Lake water (Kibos River)
Investment Capital ('000Kshs)	4,000	6,000	160,000	80,000 [237,000]

Note: Kibos river is an alternative source.
Source: Kisumu Water Supply and Sanitation Study, 1985.

Table 7.21 Kisumu Municipal Sewerage Expansion Plan

Year	1986		1995	2005
Stage of Sewerage	Immediate	Stage I	Stage IA	Stage II
Cost ('000 Kshs)	4,790	5,810	12,090	17,260
Stage of Treatment Works	Emergency	Immediate	Stage I	Stage II
Cost ('000 Kshs)	1,492	4,214	28,086	31,240
Sewerage Flow	9,900 m^3/day		23,200 m^3/day	35,400 m^3/day

Source: Kisumu Water Supply and Sanitation Study, 1985.

Table 7.22 Principal Features of Proposed Large Scale Water Resources Development Projects

Project		Teremi	Hemsted's Bridge	Rongai	Lugari	Webue Falls	Nandi Forest	Mushangumbo	Gongo
Purposes		Power	Irrigation Power	Irrigation Power	Irrigation Power	Power	Irrigation Power	Irrigation Power	Irrigation Power
River		Nzoia	Nzoia	Nzoia	Nzoia	Nzoia	Yala	Yala	Yala
Location		N00-49 E34-35	N00-46 E35-03	N00-43 E34-55	N00-38 E34-50	N00-36 E34-47	N00-09 E35-00	N00-08 E34-34	N00-05 E34-32
Catchment Area	(km2)	138	3,752	4,709	8,237	8,420	1,339	1,987	2,323
Reservoir HWL	(EL.m)		1,755	1,654	1,575	1,504	1,806	1,420	1,353
Active Storage Capacity	(MCM)	-	83	172	140	-	59	111	85
Dam Hight	(m)		49	45	62		32	36	74
Water Head	(m)		79	70	111	46	467	26	76
Install capacity	(MW)	2	10	14	28	4	45	6	14
Regulated outflow	(MCM)	ROR	233	372	636	ROR	183(diverted)	438	353
Energy output	(GWh)	12	66	85	231	32	265	36	109
Construction Cost									
Dam	(Kshs. million)	-	752	1,296	2,224	-	816	512	1,248
Power	(Kshs. million)	48	176	208	352	112	512	144	176
total	(Kshs. million)	48	928	1,504	2,576	112	1,328	656	1,424
Unit construction cost									
regulated outflow	(Kshs./m3)		1.1-2.2	1.2-2.3	1.2-2.3	-	1.5-3.0	0.4-0.8	1.2-2.4
power	(Kshs. 1000/kW)	24	43-68	46-77	39-66	28	17-24	52-81	42-72

Project		Londiani	Koru	Awasi	Twin bridge	Orokiet	Magwagwa	Sondu	Namba Kodero
Purposes		Water supply	Irrigation Power Flood control	Irrigation Power Flood control	Irrigation Power Flood control	Water supply Power	Irrigation Power	Irrigation Power	Irrigation Power Flood control
River		Nyando	Nyando	Nyando	Nyando	Sondu	Sondu	Sondu	Kuja/Migori
Location		S00-07 E35-35	S00-12 E35-14	S00-09 E35-07	S00-02 E35-11	S00-44 E35-06	S00-28 E35-02	S00-23 E34-51	S00-59 E34-17
Catchment Area	(km2)	149	1,322	1,509	584	1,081	3,160	3,360	2,769
Reservoir HWL	(EL.m)	2,292	1,360	1,260	1,343	1,760	1,663	1,368	1,212
Active Storage Capacity	(MCM)	22	66	121	49	160	591	1	50
Dam Hight	(m)	45	51	50	44	47	101	WEIR	59
Water Head	(m)	-					159	138	60
Install capacity	(MW)	-	2	3	2	3	95	49	10
Regulated outflow	(MCM)	19	104	132	69	186	760	760(diverted)	328
Energy output	(GWh)	-	15	20	11	21	334	252	81
Construction Cost									
Dam	(Kshs. million)	336	1,104	1,200	1,184	832	1,056	240	1,152
Power	(Kshs. million)	-	80	64	48	80	1,760	912	144
total	(Kshs. million)	336	1,184	1,264	1,232	912	2,816	1,152	1,296
Unit construction cost									
regulated outflow	(Kshs./m3)		3.5-7.1	3.0-6.1	5.7-11.4	1.5-3.0	0.5-0.9	0.1-0.2	1.2-2.3
power	(Kshs. 1000/kW)		224-408	155-288	221-419	119-212	22-26	20-22	53-91

Note: 1) A plant factor of 0.5 is assumed.
2) A long waterway plan is contemplated to utilize the head created by Webuye Falls efficiently.
3) The allocation of dam cost to power generation is tentatively assumed to be between 1/3 and 2/3.

Source JICA Study Team.

Table 7.23 Alternative Development Schemes

Project		Capital Cost (Million Kshs.) 7,504 or more case 1	6,176 case 2	4,080 case 3	2,720 case 4	Capital Cost (Million Kshs.) 8,592 or more case 5*	2,384 case 6*
Dam and Power at							
Magwagwa	(GWH/year)	334	334	-	-	334	-
Sondu/Miriu	(GWH/year)	252	252	170	170	252	-
Londiani(w/s)	(m3/sec)**	0.6	0.6	0.6	0.6	0.6	0.6
Awasi	(m3/sec)	-	-	-	-	-	-
Nandi Forest	(GWH/year)	265	-	265	-	265	265
Irrigation of Nyando left bank by							
Sondu R.	(ha)	10,600	10,600	9,000	9,000	10,600	-
Nyando R.	(ha)	5,000	5,000	1,000	1,000	5,000	1,000
L. Victoria	(ha)	-	-	-	-	-	-
Yala Swamp	(ha)	17,500	17,500	17,500	17,500	17,500	17,500
Irrigation of Nyando right bank by							
Yala R.	(ha)	15,000	-	15,000	-	10,000	10,000
Nyando R.	(ha)	10,000	10,000	3,000	3,000	10,000	3,000
L. Victoria	(ha)	-	-	-	-	-	-
Water supply to Kisumu by							
Yala R.	(m3/sec)	-	-	-	-	2	2
Nyando R.	(m3/sec)	-	-	-	-	-	-
L. Victoria	(m3/sec)	2	2	2	2	-	-
Cost & benefit for the selected projects							
Total cost	(Million Kshs.)***	6,576	5,488	3,744	2,608	7,488	2,320
Benefit	(Million Kshs.)	11,280	9,440	6,848	5,008	11,248	3,376
Net benefit	(Million Kshs.)	4,704	3,968	3,104	2,400	3,760	1,056

Notes: * Exclude use of Lake Victoria water.
** Cost of Londiani is excluded.
*** Include capital, operation and maintenance cost.

Table 7.24 Cost of Flood Protection Measures in Kano Plain (1/2)

Main Rivers Flood Control

River	Type of work	Cost (M.KShs.)
Nyando	embankments, gabions, bridge, drain, Soil conservation	135.7
Lielango	embankments, gabions, bridge	22.5
Kibos	embankments, gabions, bridge, drain, terminal structure	26.5
Total		184.6

Oroba - Nyando Diversion

	Type of Work	Cost (M.KShs.)
Total	excavation,embankment, gabions, bridge	57.0

Main Drians

	Type of work	Cost (M.KShs.)
Ombeyi-Miriu	excavation, gabions, bridge	33.9
Miriu-Nyando	excavation, gabions, bridge	20.3
South-Eastern	embankment,gabions	17.0
Kibos-Lielango	excavation, gabions, bridge	12.5
Oroba-Lielango	excavation, gabions, bridge	62.0
Nyando-South East	excavation, gabions, bridge	19.2
Total		165.0

Secondary Drains

	Type of work	Cost (M.KShs.)
Total	field drains, unit drains, district drains, main drains KShs. 17,000/ha x 30,000ha	510.0

Grand total of the whole Kano Plain	Without secondary drain	407.0
	With secondary drain	917.0

Source: Italconsult (see text).

Table 7.24 Cost of Flood Protection Measures in Kano Plain (2/2)

Main Rivers Flood Control

River	type of work	Cost(M. KShs.)
Kibos	embankment,gabions, 1 bridge	14.0
Nyando	embankment, excavation, gabions, 1 bridge	59.0
Awach-Kano	embankment, excavation, gabions	25
Aswawo	rehabilitation	1.0
Sub-total		99.0
Total (with additional cost of engineering etc.)		150.0

Oroba Flood Plain and Lielango Reservoir

River	Type of work	Cost(M. KShs.)
Oroba (Flood Plain)	bulk excavation, embankment, concrete works, 2 gabions	22.0
Lielango Reservoir	bulk excavation, embankment,gabions, rip-rap, toe drain, well graded filter	57.5
	Central Kano Embankment	3.0
Total		82.5

Main and Secondary Drainage Canals

	Location	Cost(M. KShs.)
Main	Oroba-Lielango, Luando-Mayenya Lower Luando, Ombeyi, Upper Ombeyi. Lower Ombeyi, Miriu, Nyando Drain	66.0
Secondary	Obuso, Lower Miriu, Lower Nyando Lower Oroba	9.0
Total		75.00

Grand total of whole Kano Plain	308.00

Source: Lotti (see text).

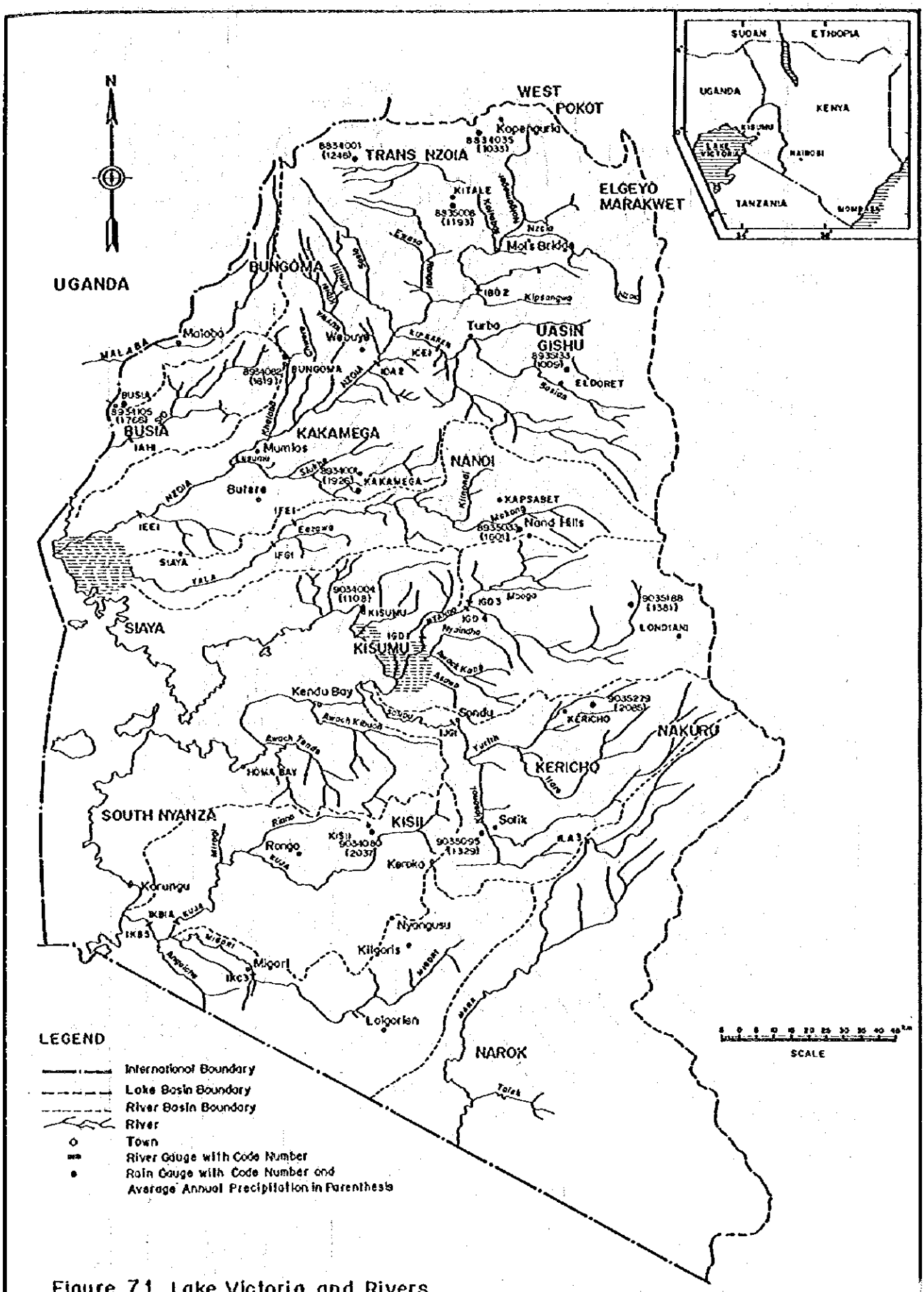


Figure 7.1 Lake Victoria and Rivers

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

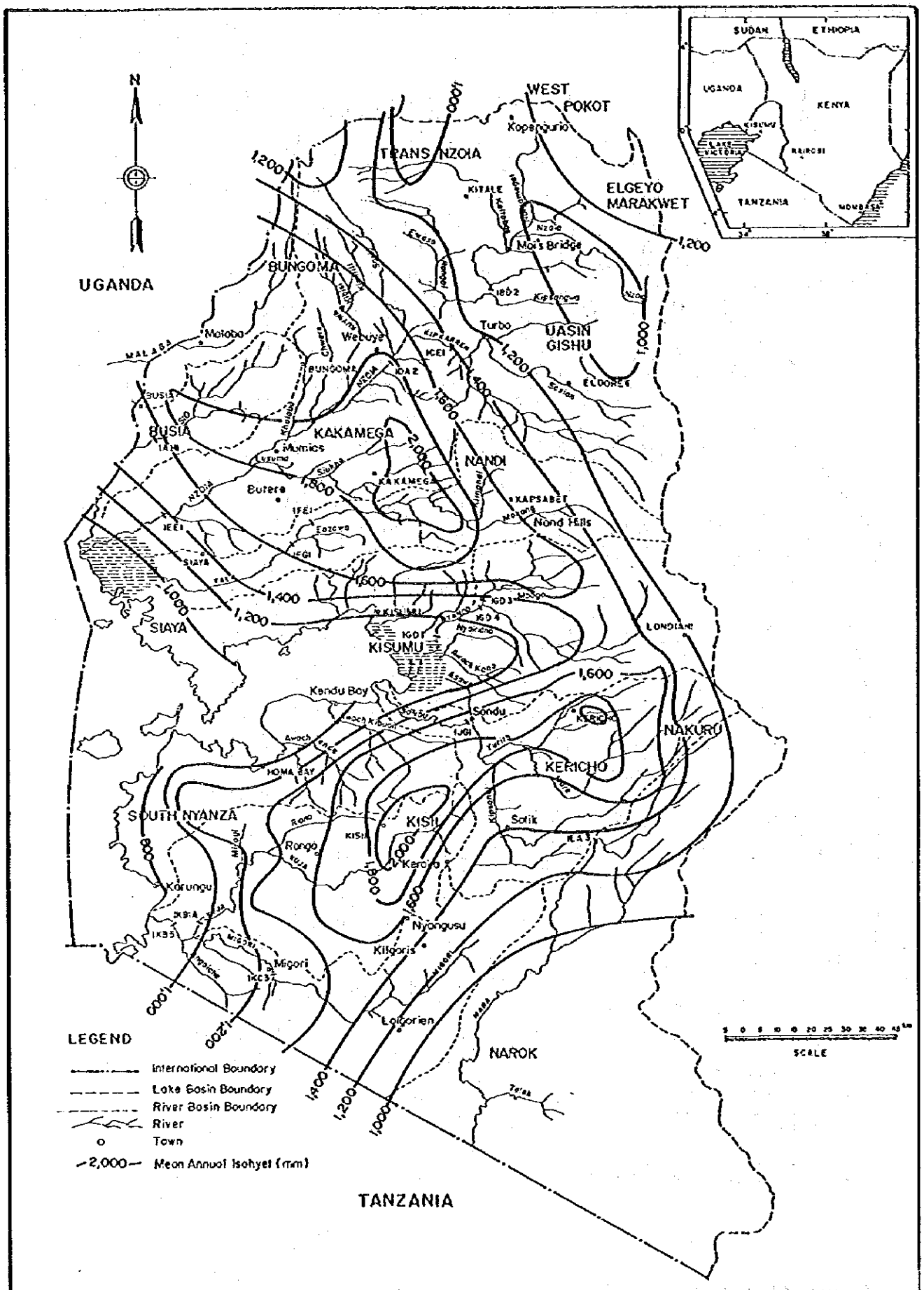


Figure 7.2 Lake Basin Area and Isohyet

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

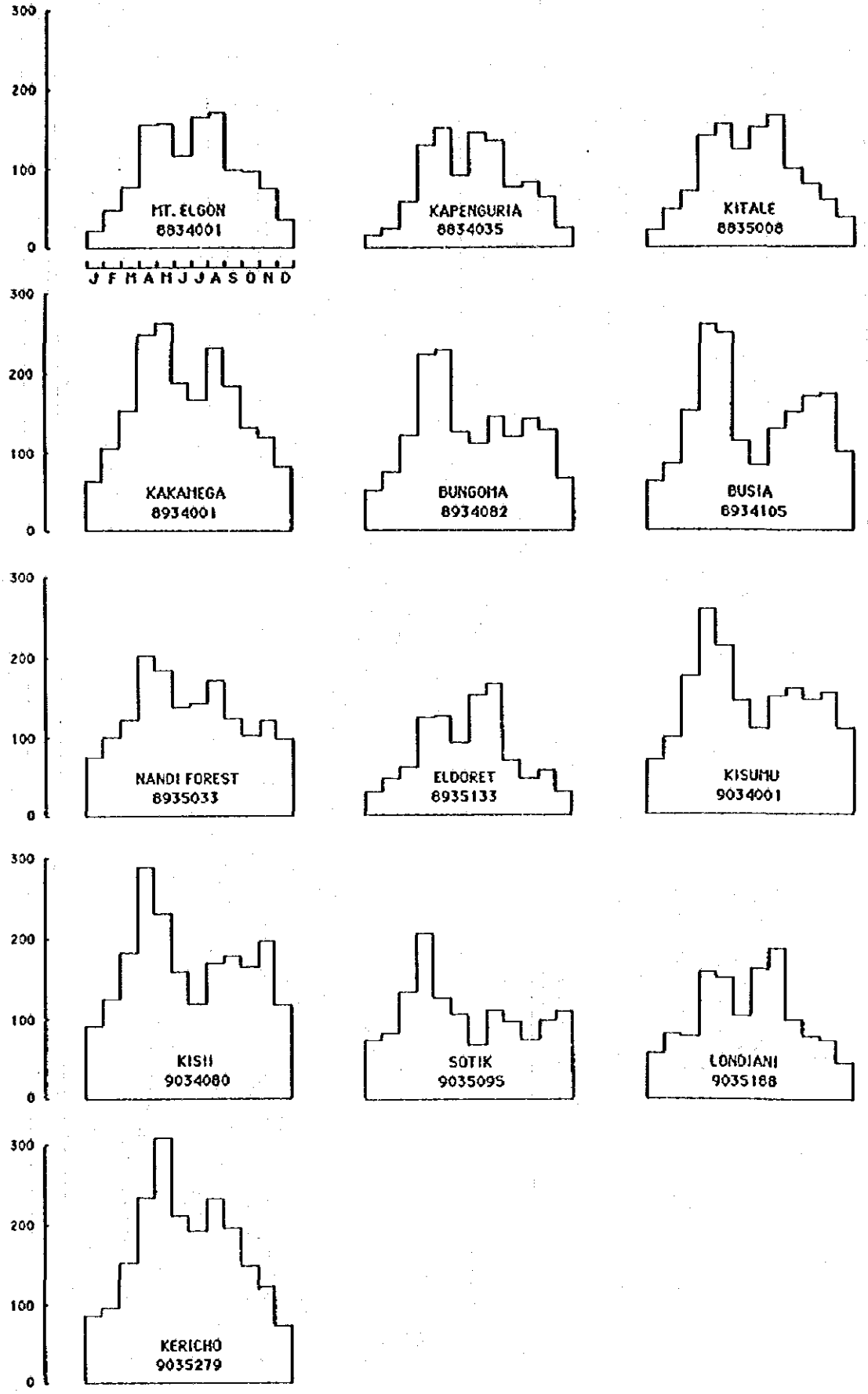


Figure 7.3 Mean Monthly Rainfall

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

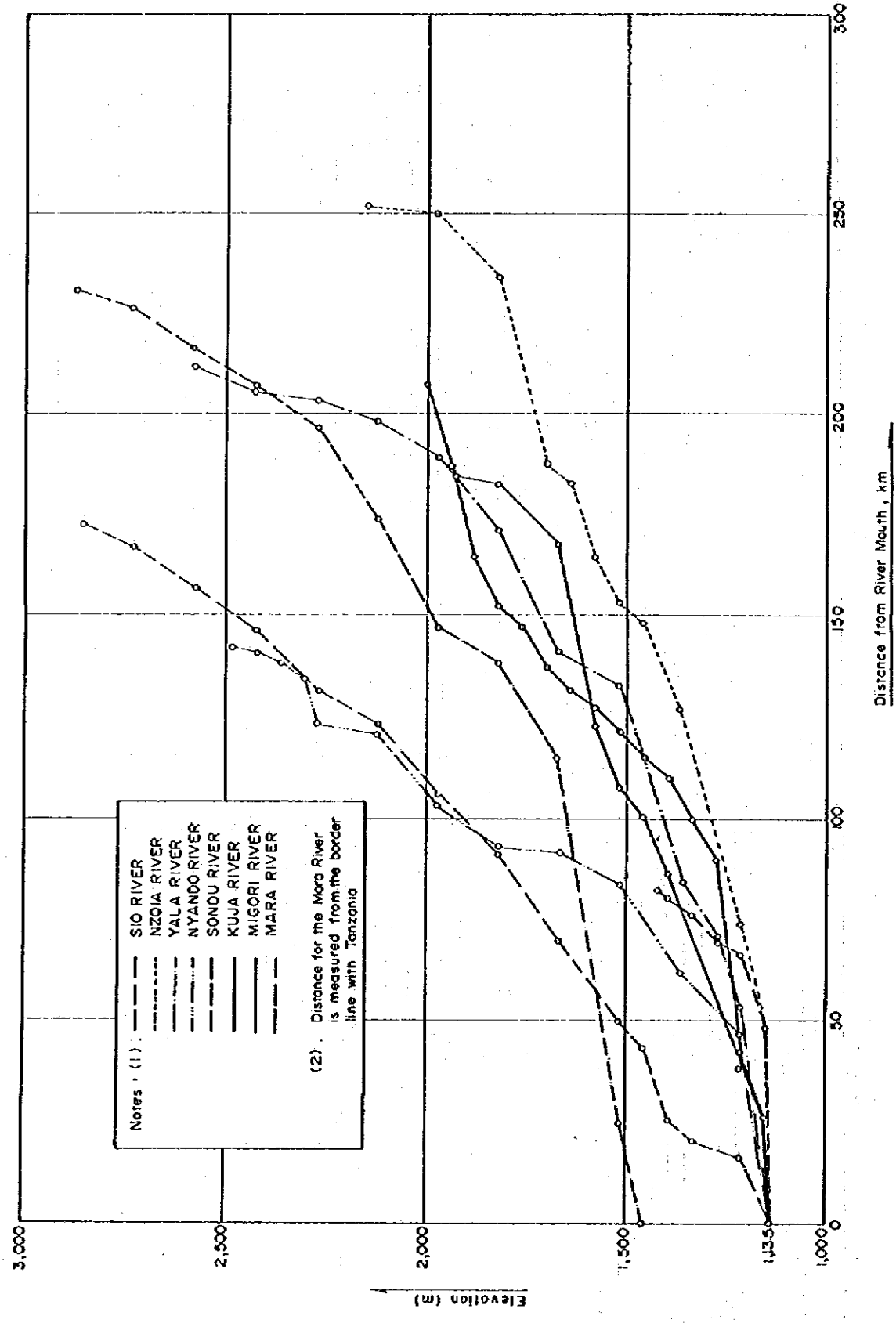


Figure 7.4 Longitudinal Profile of Major Rivers

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

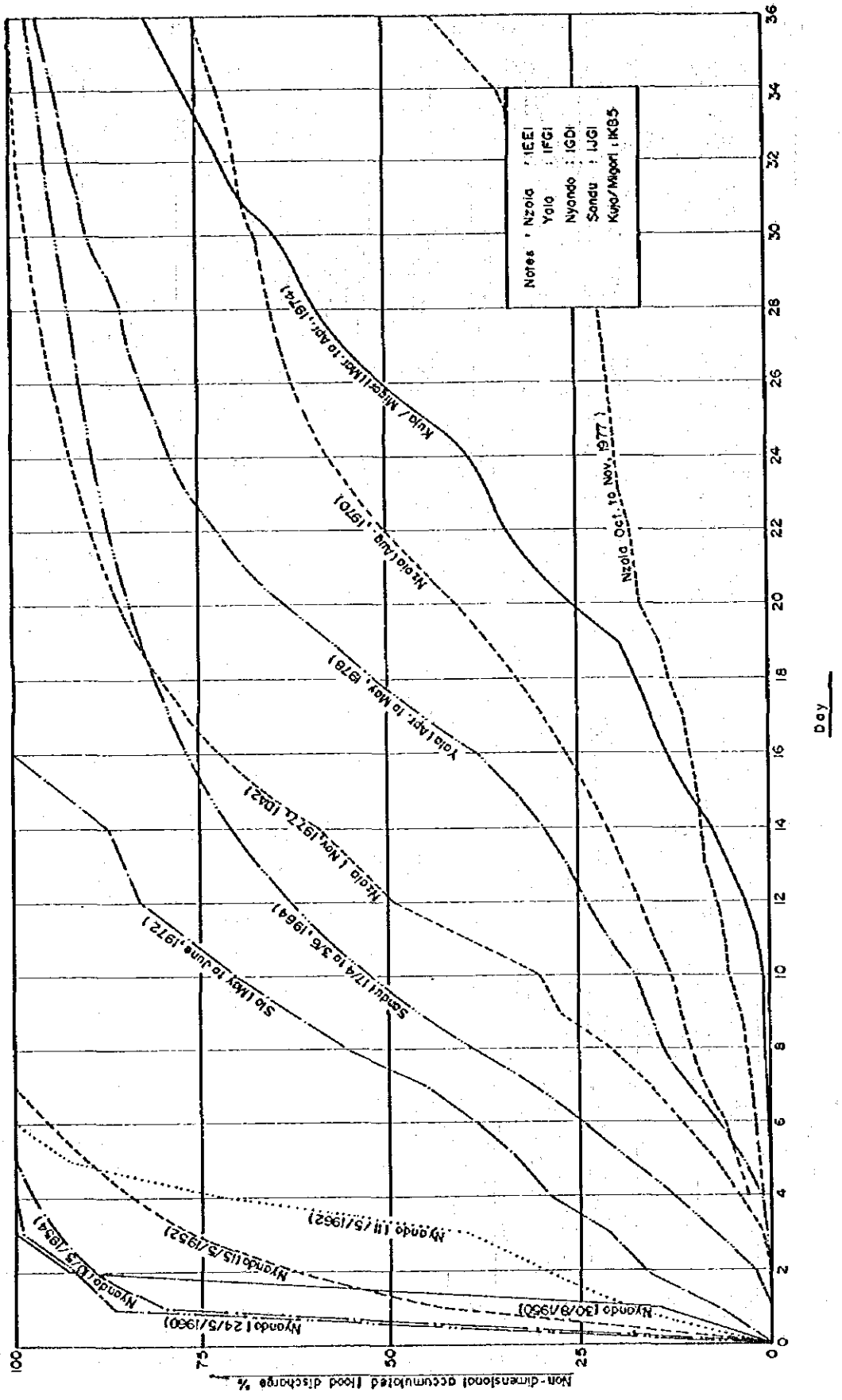


Figure 7.5 Nondimensional Accumulated Flood Hydrographs

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

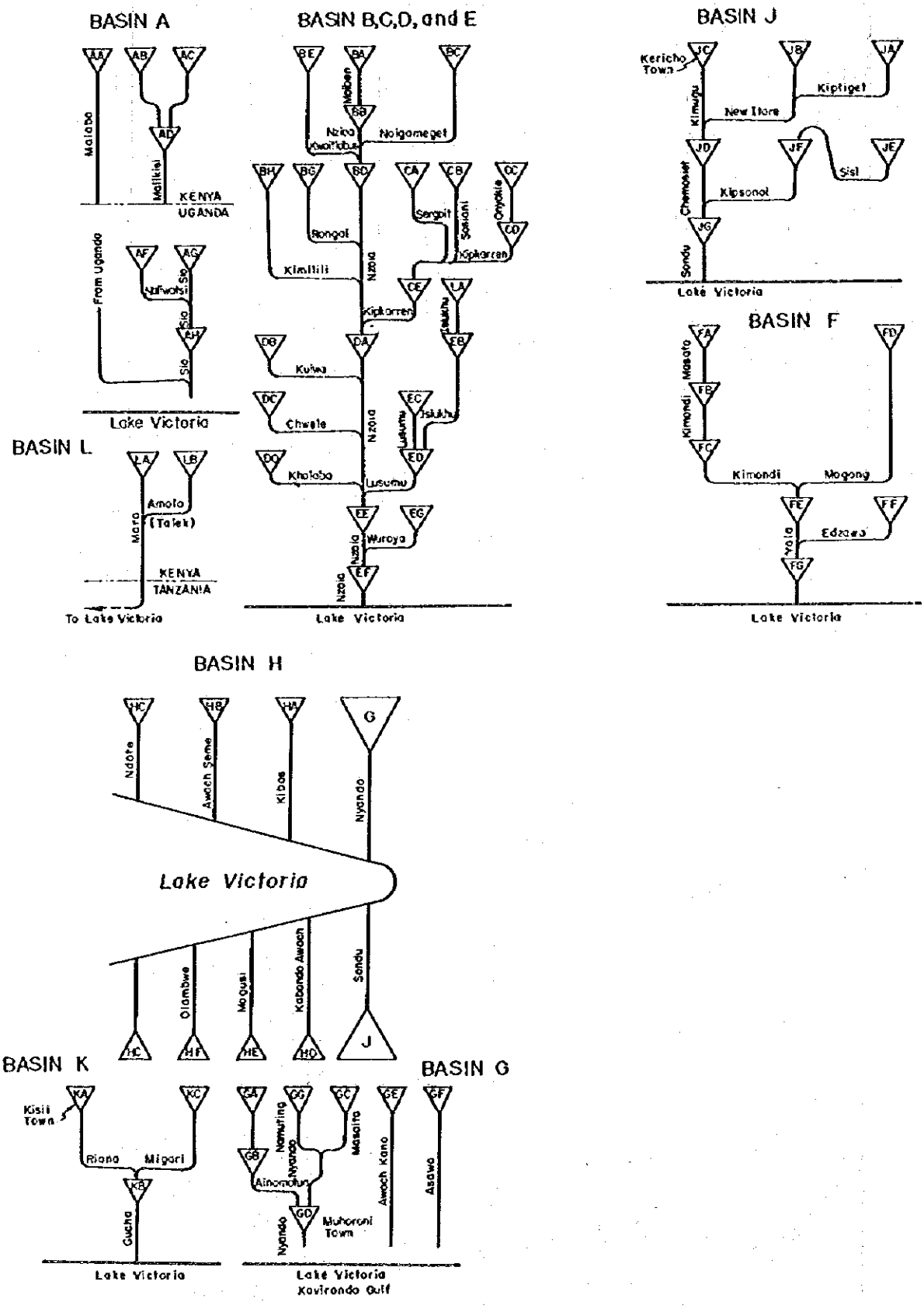
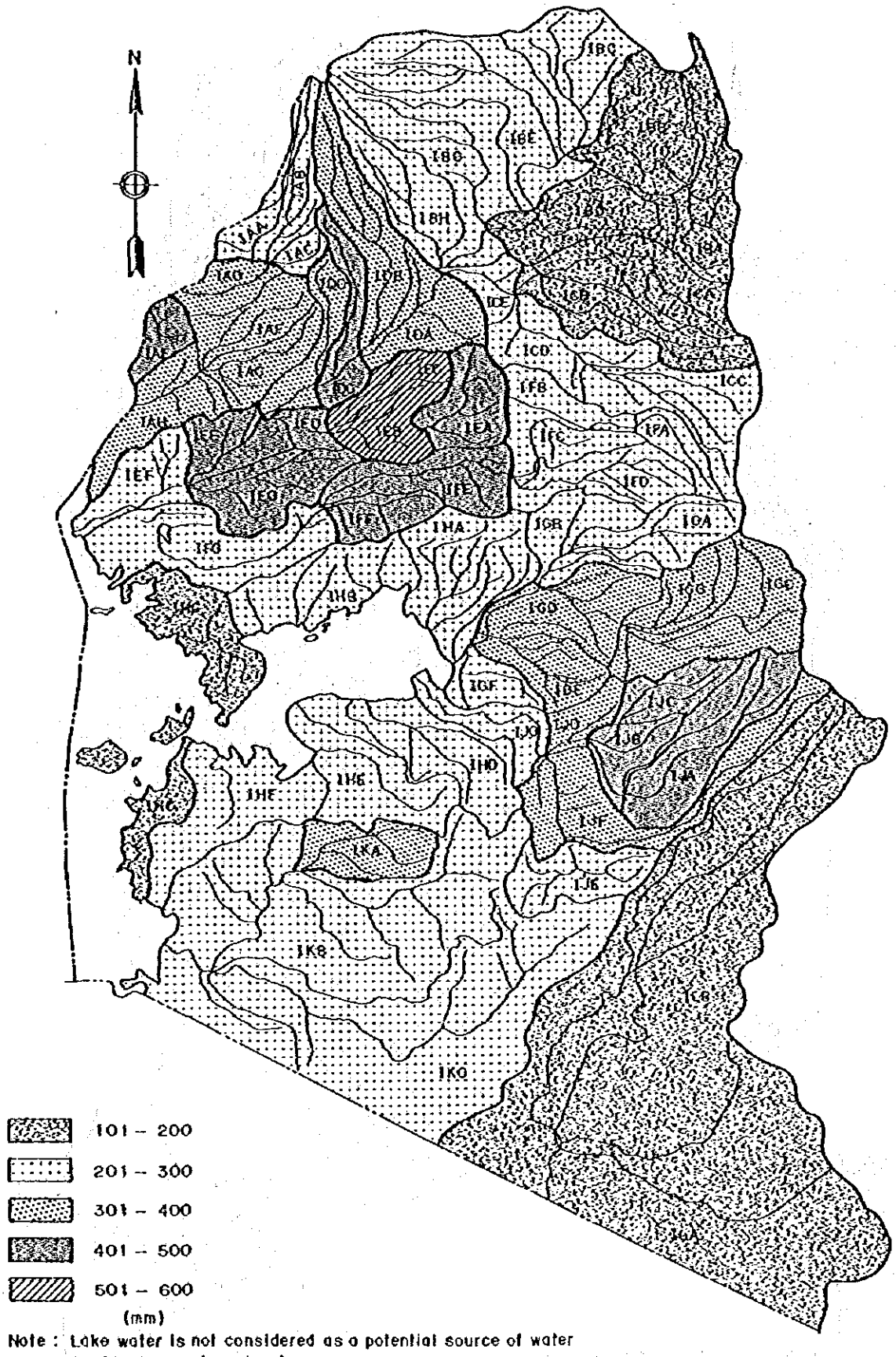


Figure 7.6 Configuration of River Basin and Subbasin

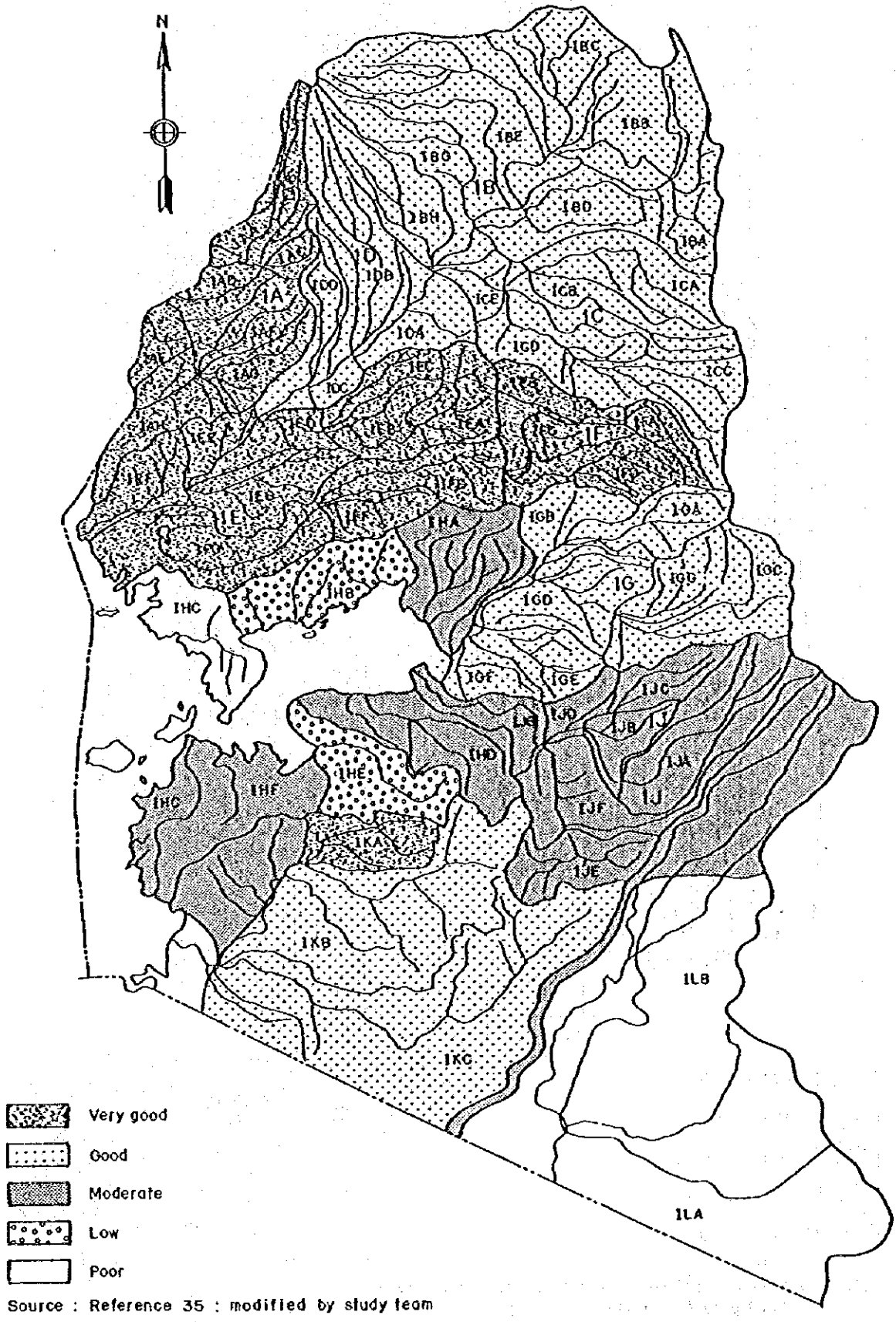
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Note : Lake water is not considered as a potential source of water in this figure (see text).

Figure 7.7 Surface Water Potential by Subbasin

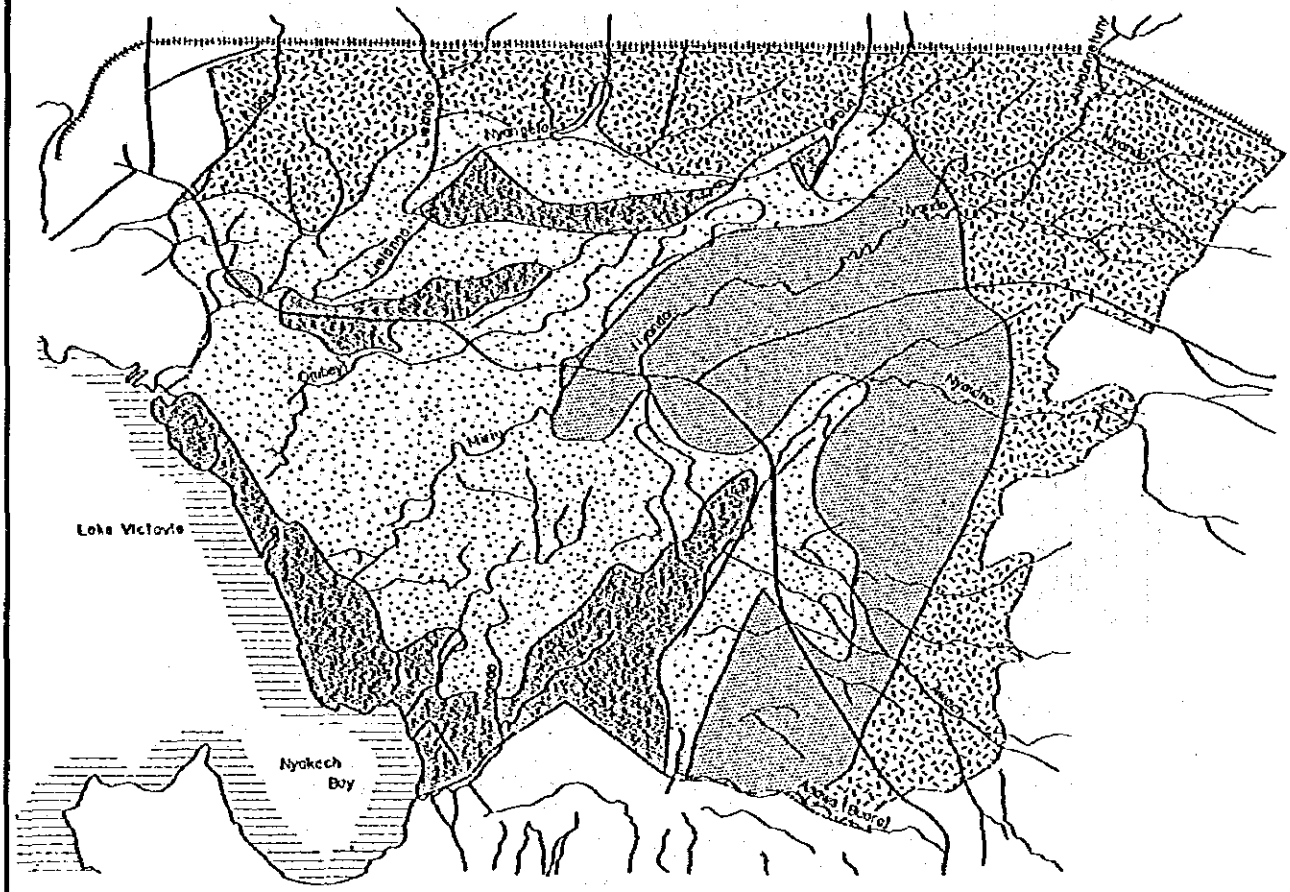
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Source : Reference 35 : modified by study team

Figure 7.8 Ground Water Potential by Subbasin

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Permanent Swamp

Low Lying Areas Liable to Seasonal Flooding

Low Lying Areas with Easy Drainage

High Lying Areas with Easy Drainage and Slope not More than 2%

Kano Plains

Figure 7.9 Area Susceptible to Flood in Kano Plain

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY

THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

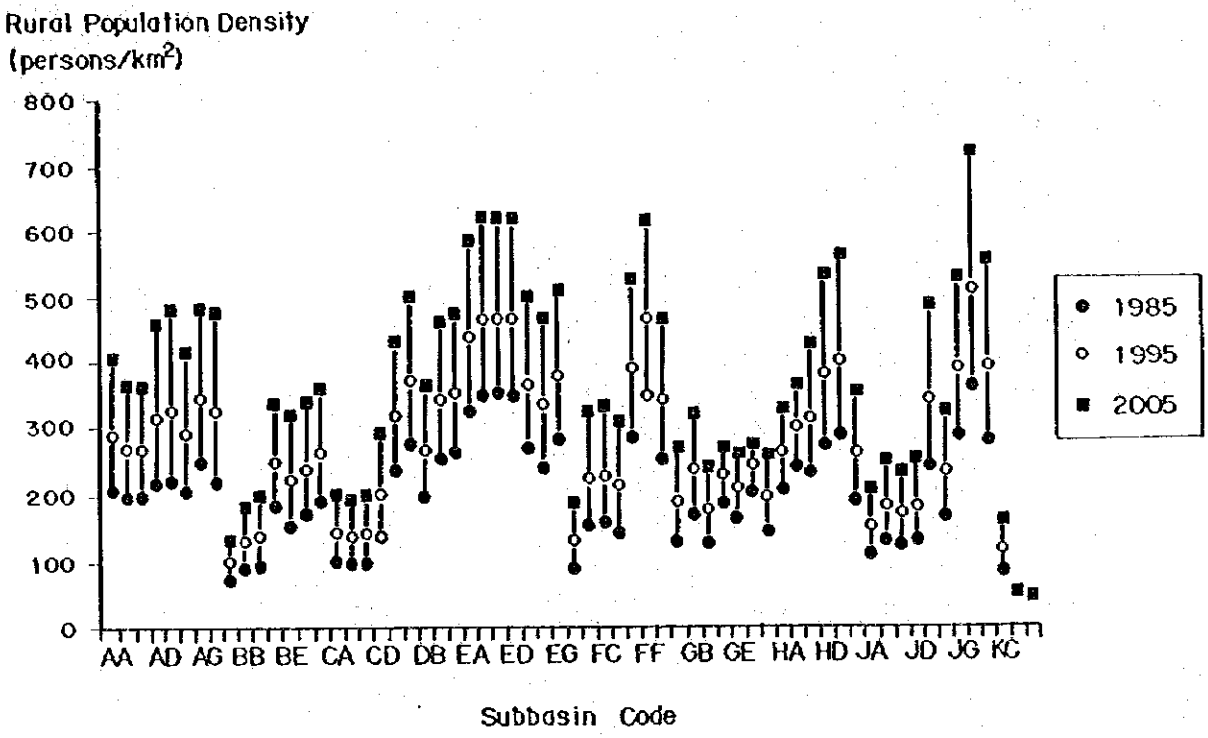
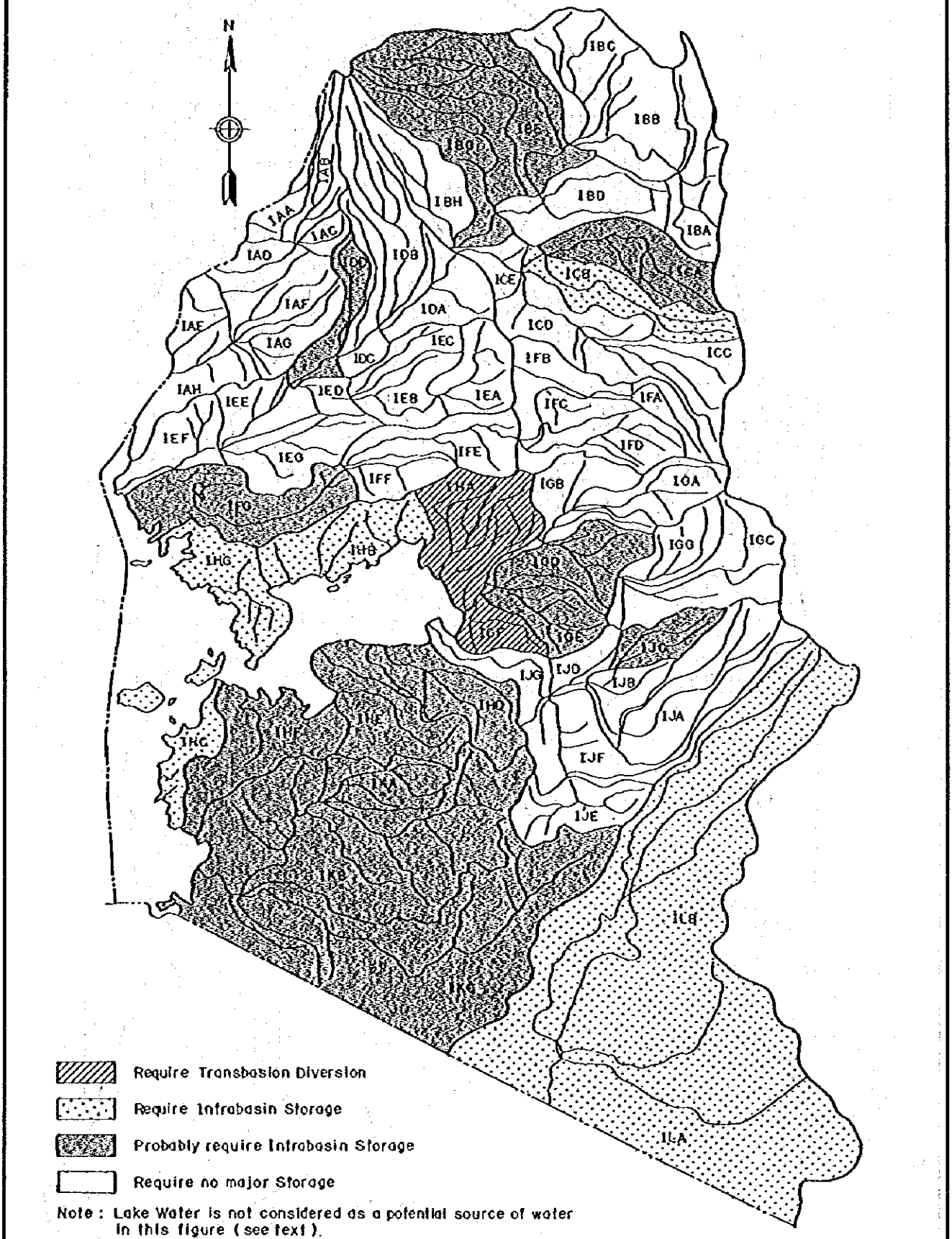


Figure 7.10 Population Density by Subbasin

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY



Note : Lake Water is not considered as a potential source of water in this figure (see text).

Figure 7.11 Water Demand and Supply Balance in 2005

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

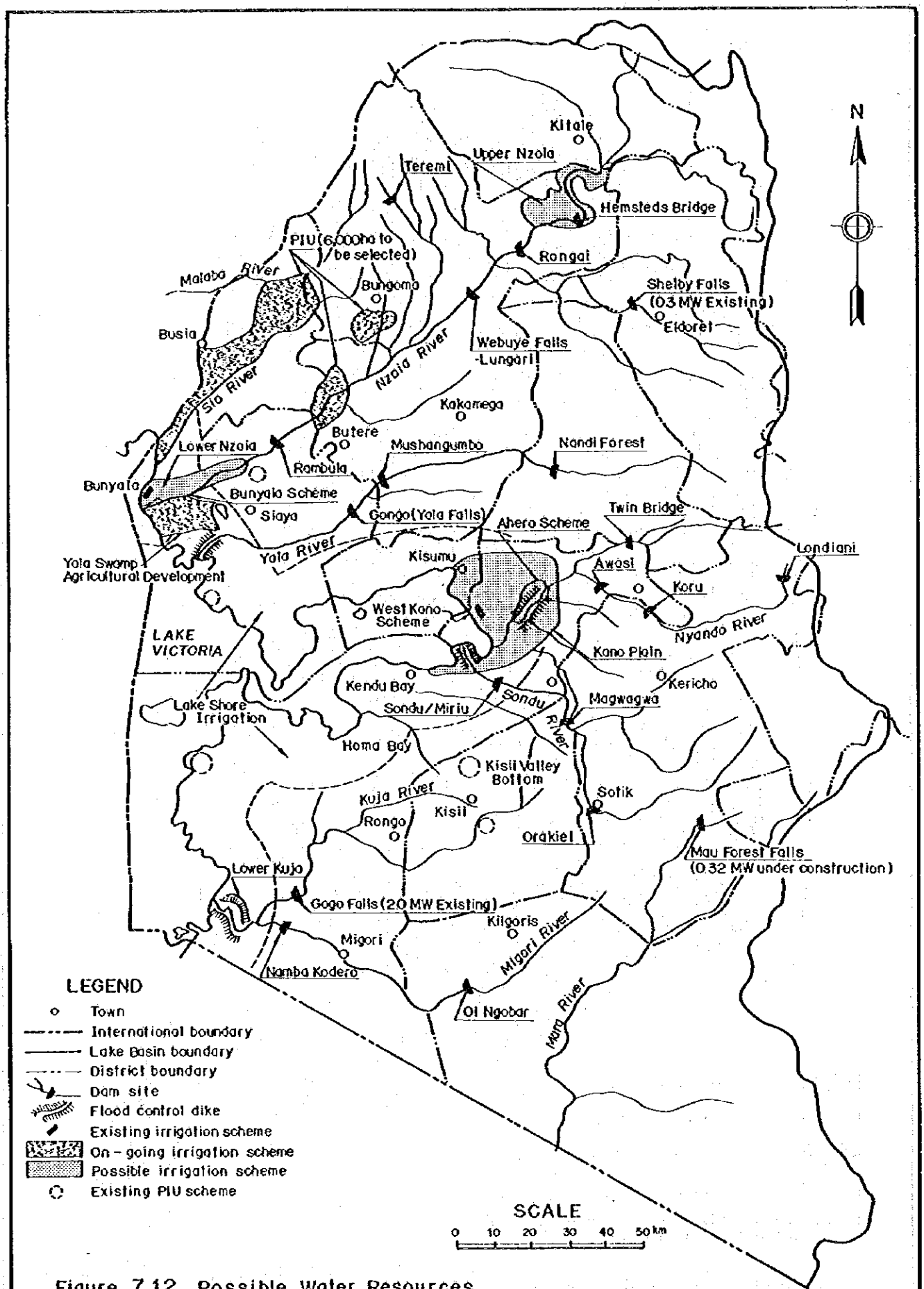
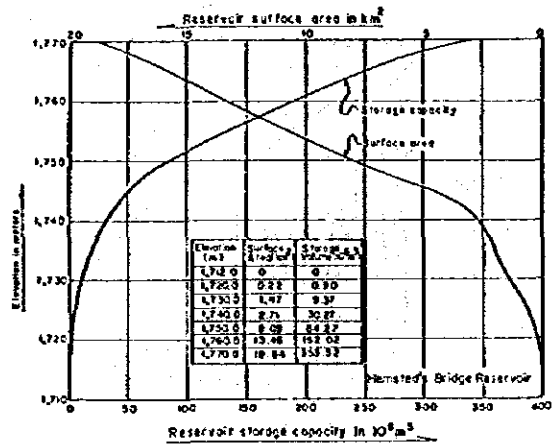
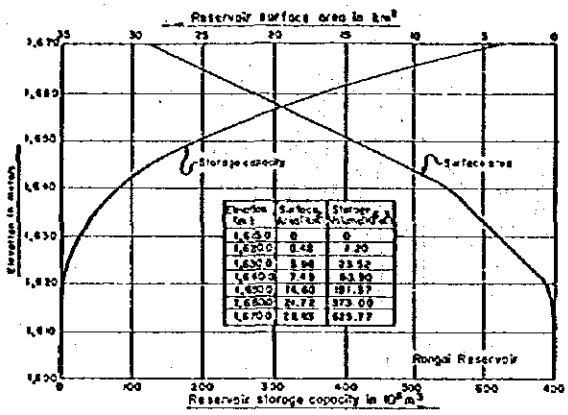
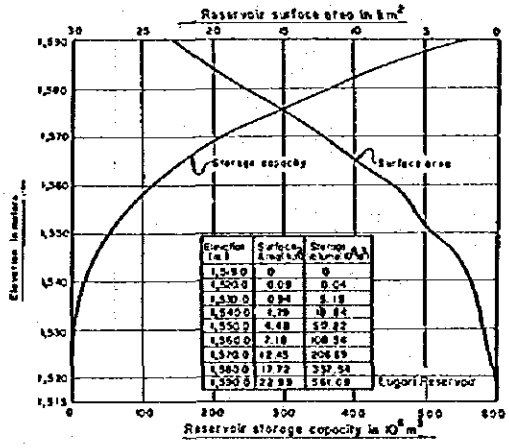


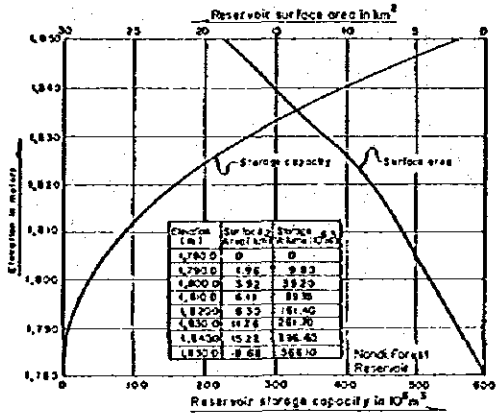
Figure 7.12 Possible Water Resources and Irrigation Development Projects

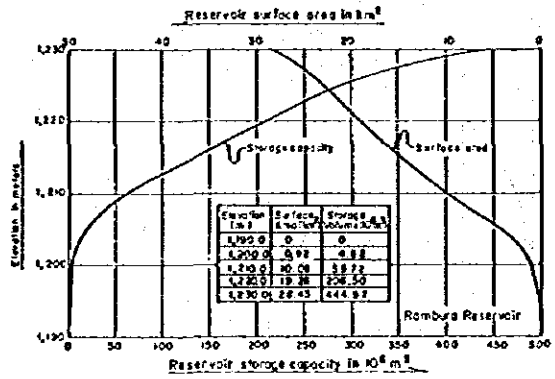
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY











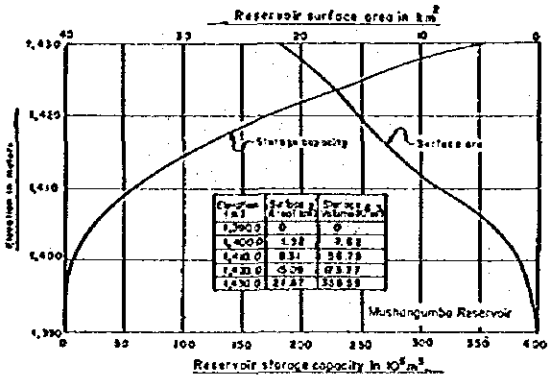
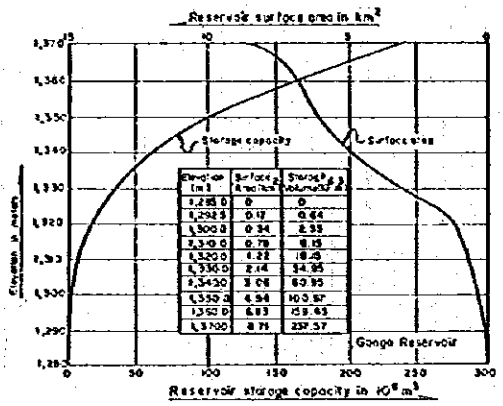
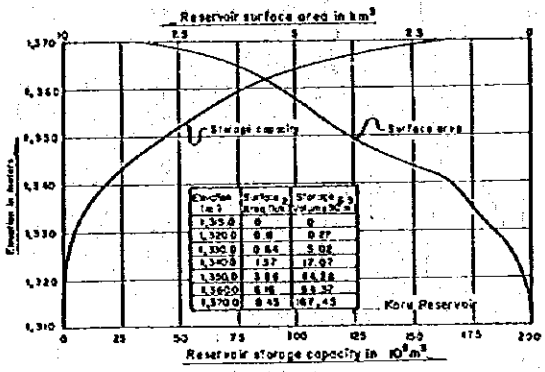
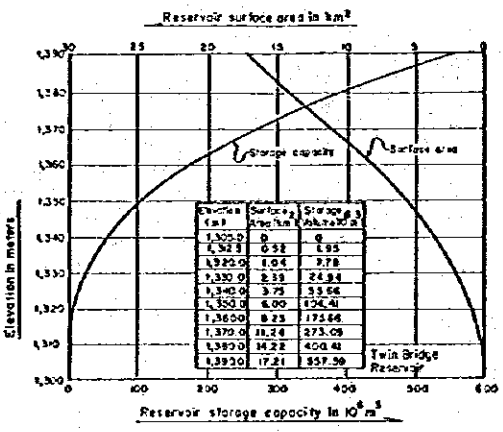


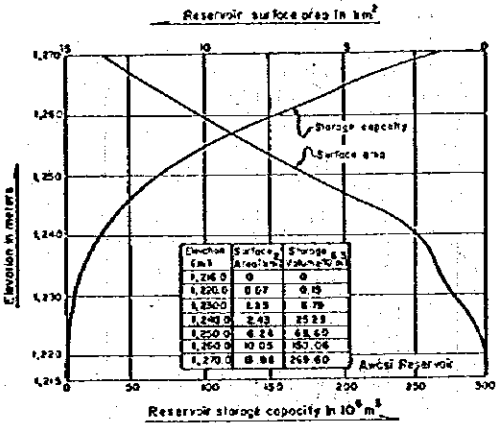
Figure 7.13 Area - Storage Curves for Reservoir Projects (1/3)

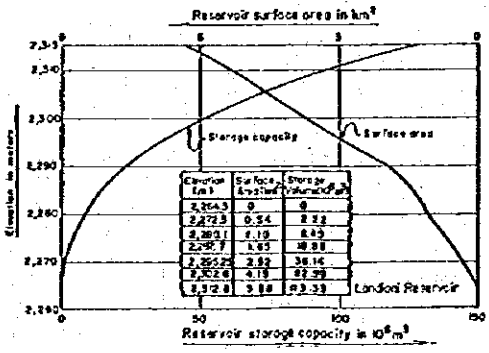
REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY











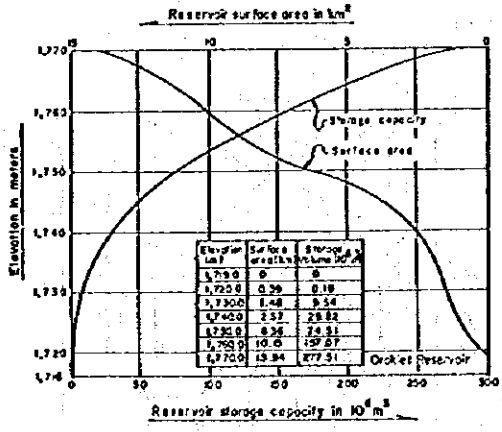
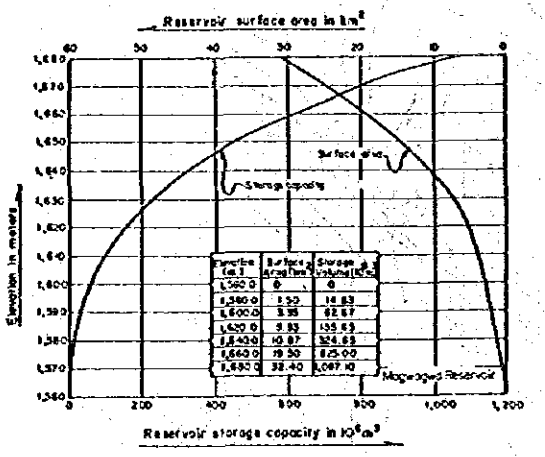
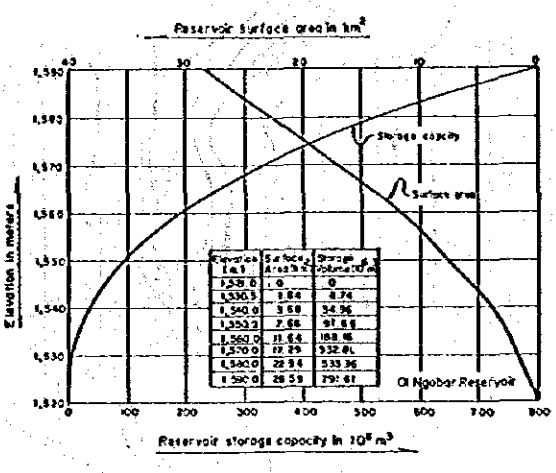


Figure 7.13 Area-Storage Curves for Reservoir Projects (2/3)

REPUBLIC OF KENYA, LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY





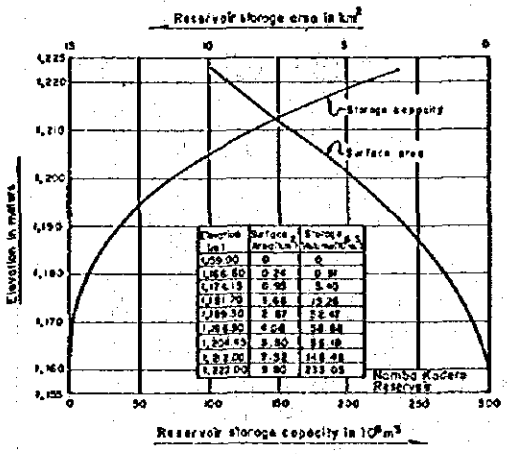
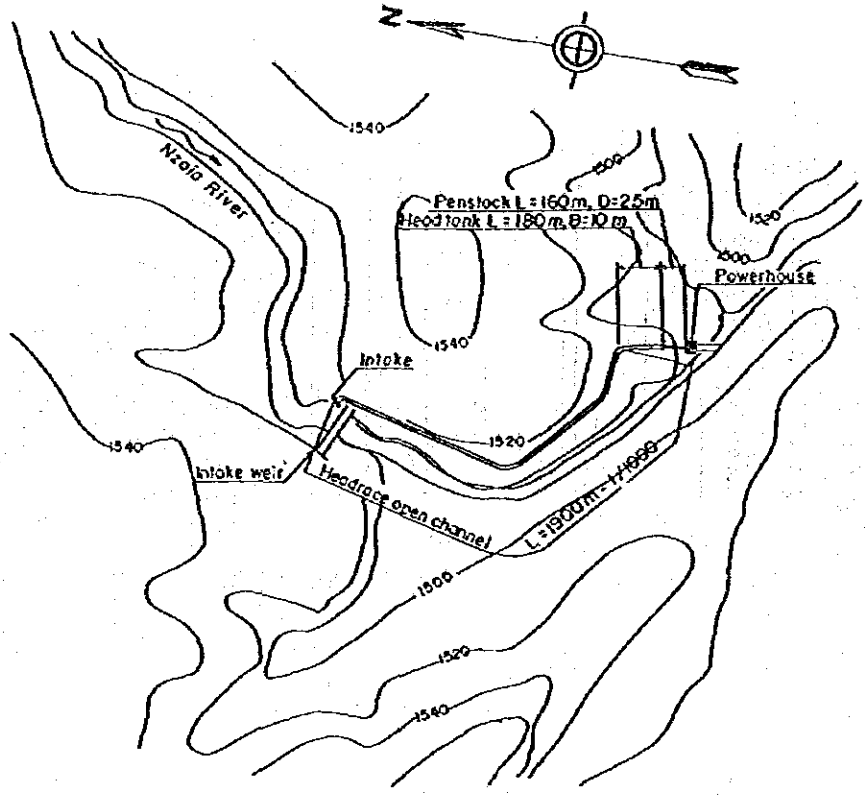


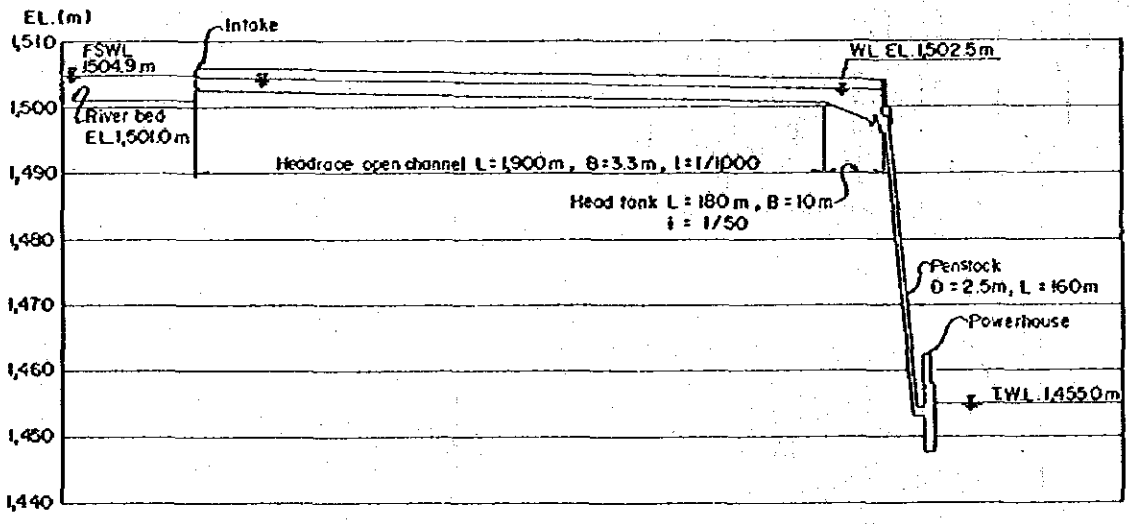
Figure 7.13 Area - Storage Curves for Reservoir Projects (3/3)

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY	
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA	
JAPAN INTERNATIONAL COOPERATION AGENCY	



PLAN
Webuya Falls Project

0 250 500 750 1000m
SCALE



PROFILE
Webuya Falls Project

Horizontal 0 200 400 600 m
Vertical 0 10 20 30 m
SCALE

Figure 7.14 Plan and Profile of Water Resources Project (Webuye)

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

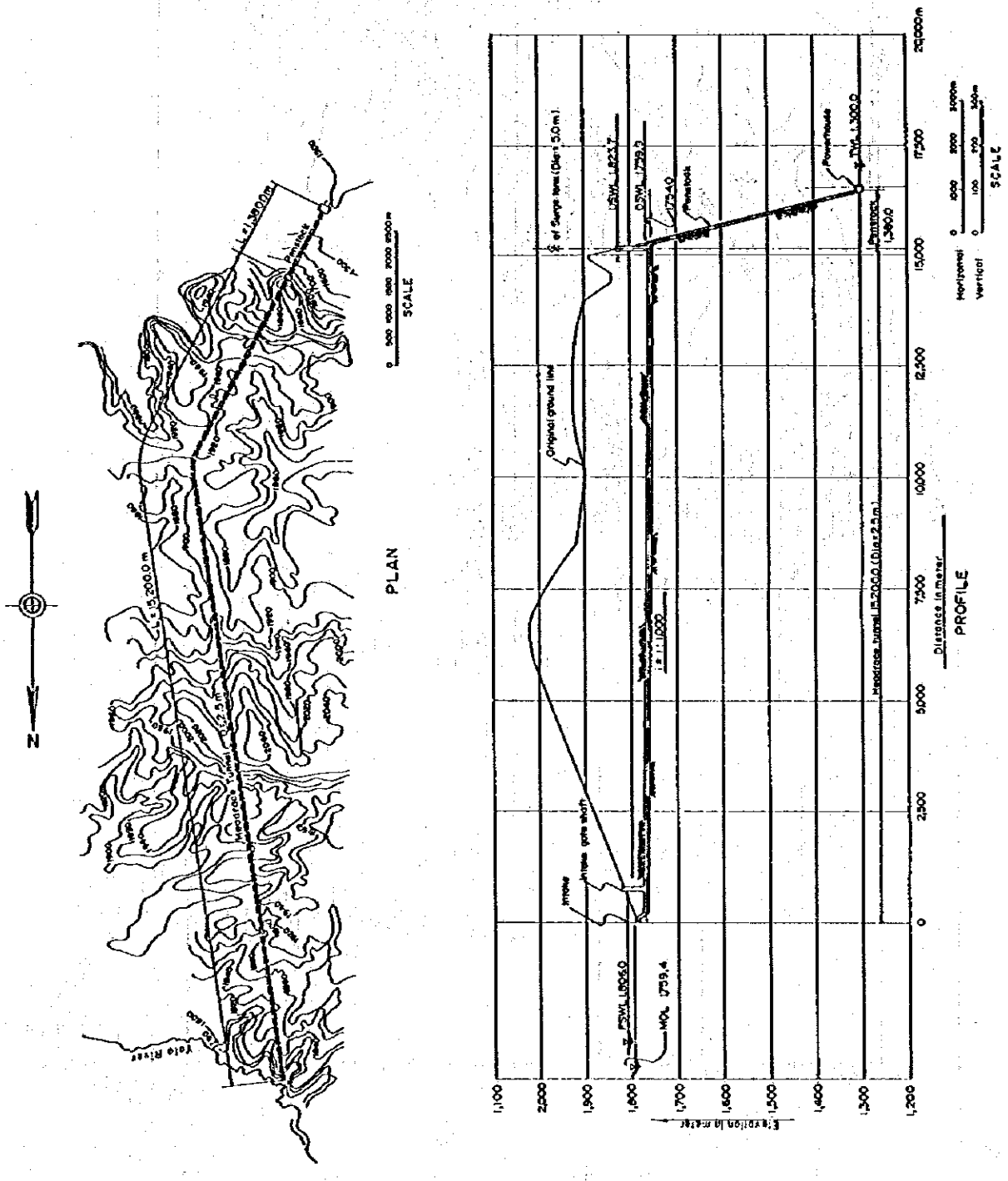


Figure 7.15 Plan and Profile of Water Resources Project (Nandi Forest)

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY

THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA

JAPAN INTERNATIONAL COOPERATION AGENCY

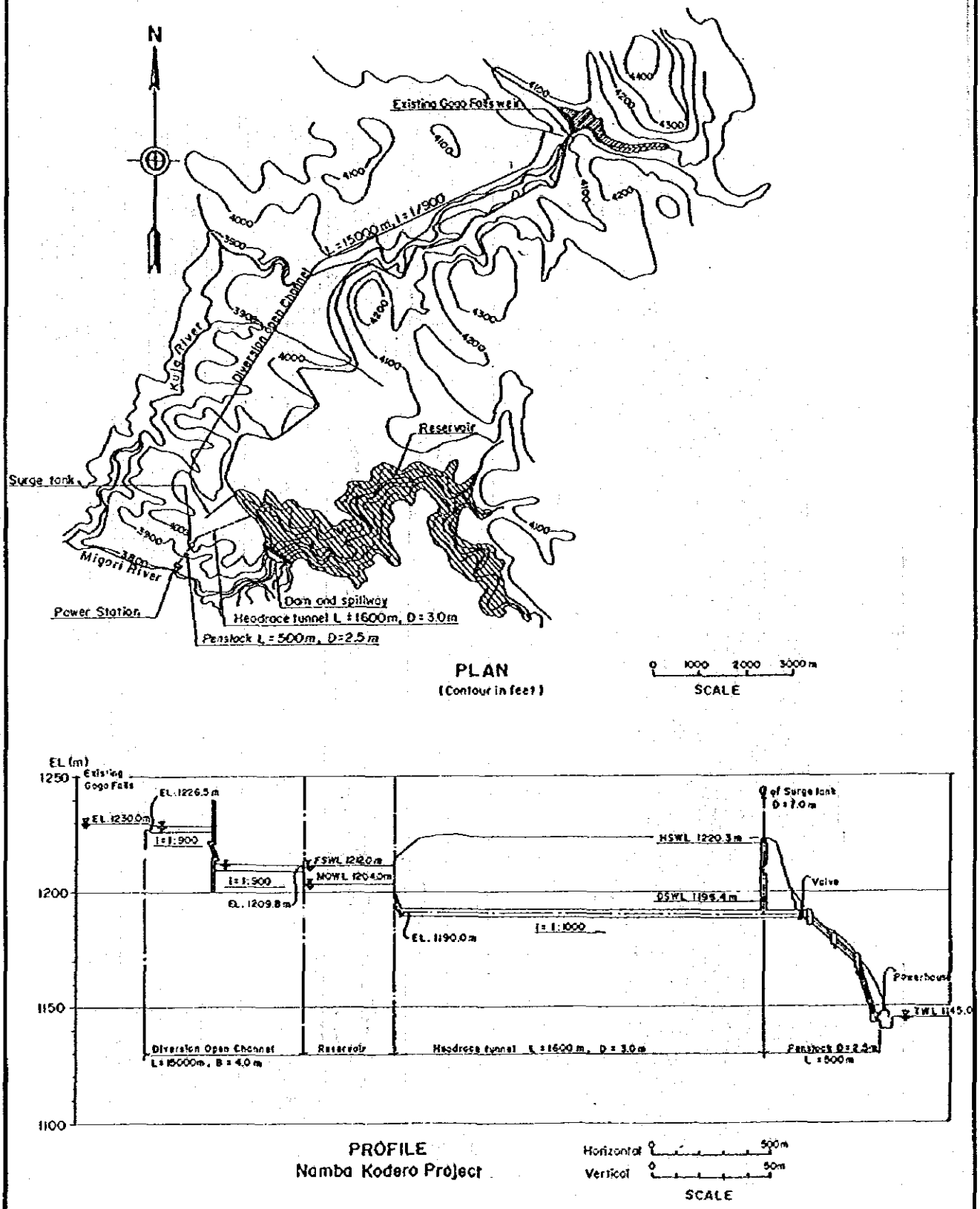


Figure 7.16 Plan and Profile of Water Resources Project (Namba Kodero)

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

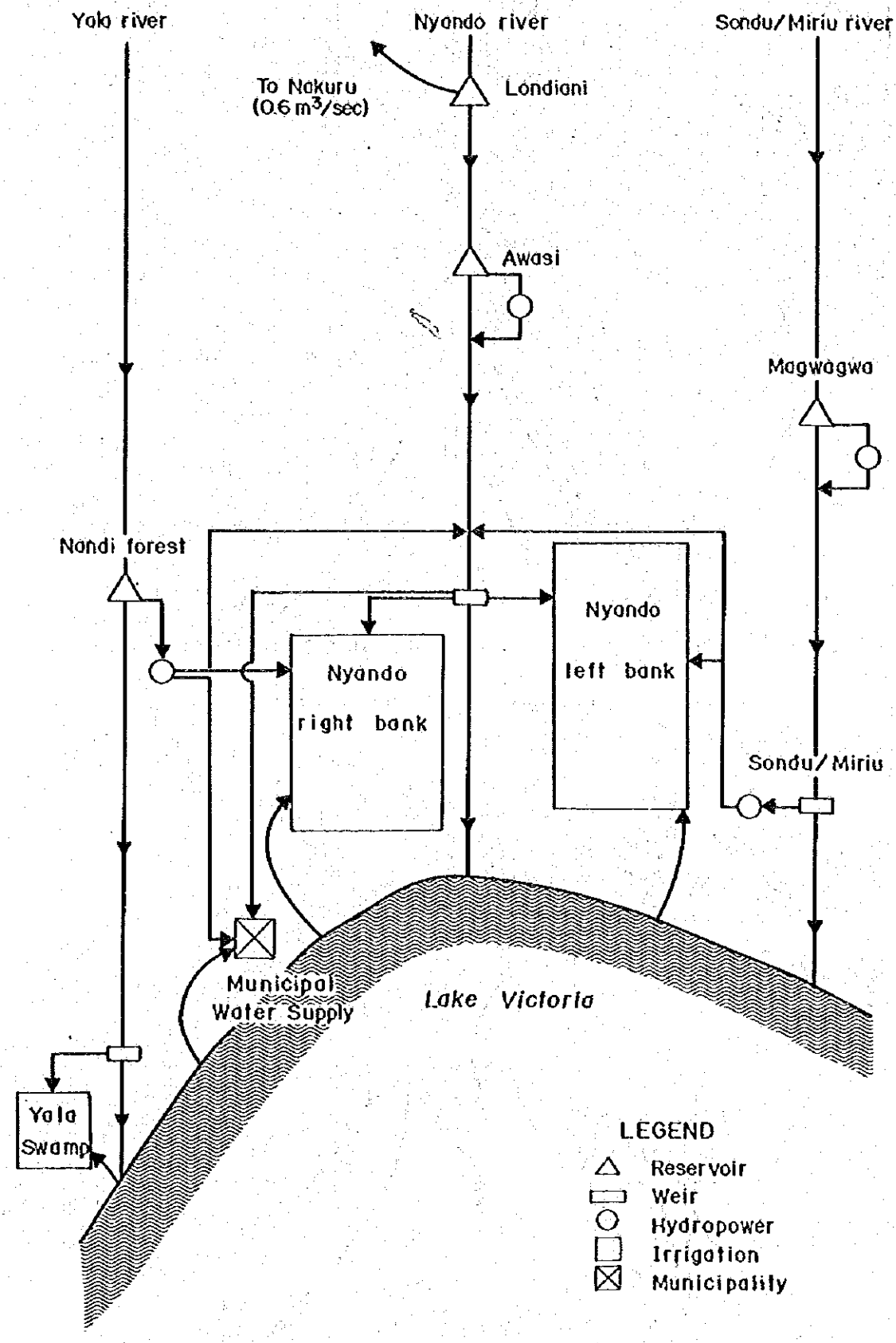


Figure 7.17 Project Components of Integrated Kano Plain Development

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

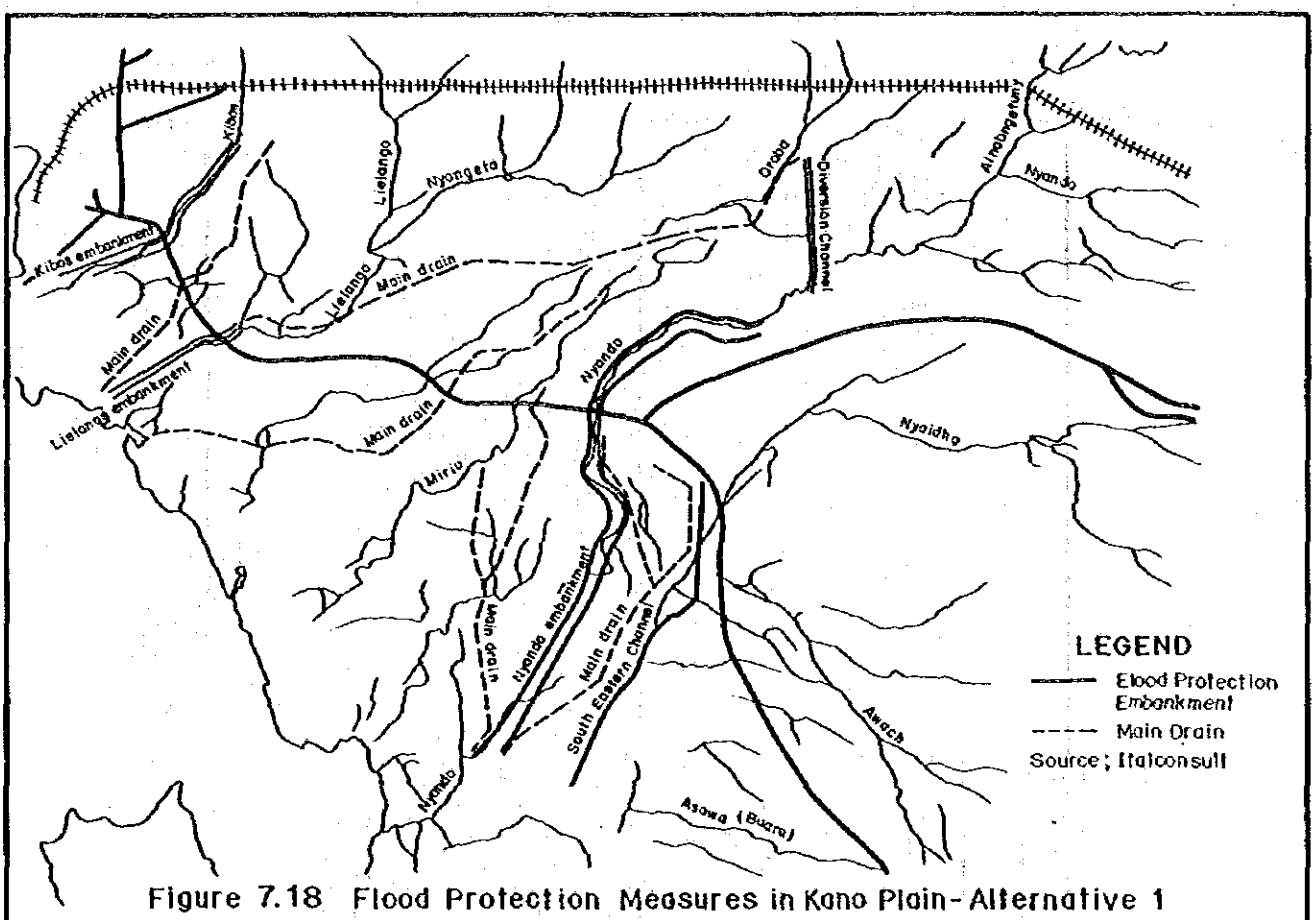


Figure 7.18 Flood Protection Measures in Kano Plain - Alternative 1

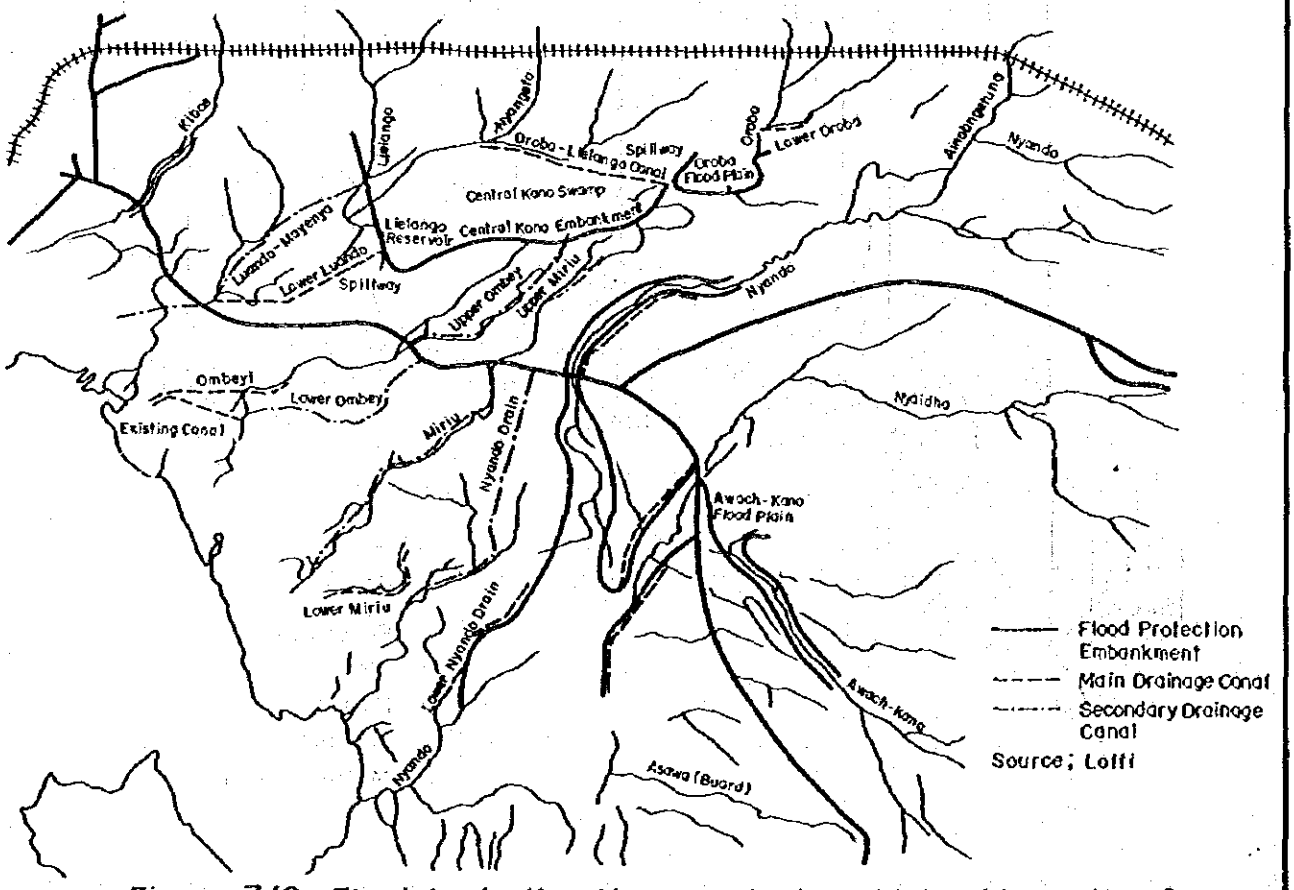


Figure 7.19 Flood Protection Measures in Kano Plain - Alternative 2

REPUBLIC OF KENYA LAKE BASIN DEVELOPMENT AUTHORITY
THE STUDY OF INTEGRATED REGIONAL DEVELOPMENT MASTER PLAN FOR THE LAKE BASIN DEVELOPMENT AREA
JAPAN INTERNATIONAL COOPERATION AGENCY

Chapter 8 TRANSPORTATION

Associated with the Integrated Regional Development Master Plan study for the LBDA region, a sector study of transportation has been carried out. The purposes of the study have been (1) to examine present conditions of transportation and related facilities, (2) to forecast future traffics in line with the planned regional development, (3) to set future directions of transportation development, and (4) to formulate specific projects and related measures for realizing the development.

The organization of this chapter generally follows the purposes of the study presented above. In Section 8.1, the present situation is described by mode of transport for passengers and goods. Future traffics are forecasted as described in Section 8.2. Strategy for transport development in the Region is clarified in Section 8.3, based on the existing conditions examined and in line with national policy for spatial development described in the Master Plan report (Section 4.1, Master Plan Report). The transportation development plan is presented in Section 8.4, consisting of specific projects and associated measures. Phasing of implementation and costs of priority projects are also presented.

CHAPTER 8 TRANSPORTATION

Contents

Tables

Figures

8.1 Present Situation

8.1.1 Movement of people

Peoples' trips generated in the Region in 1983 were 19,541 thousand trip-persons by road, 784 thousand by rail and waterway and 14 thousand by airway. These trips are broken down into inter- and intra-district trips as shown in Table 8.1. Travelling by road covers 96.4% of all the trips, which is slightly higher than the share of road trips in Kenya of 94.5% (Table 8.2). This may be a reflection of more developed classified roads, A, B and C, having the density of 0.075, 0.089 and 0.029 km/km^2 respectively in Nyanza, Western and Rift Valley Provinces, while the average density of these roads in Kenya is 0.024 km/km^2 (Table 8.3).

There is a hierarchy in people's trips, centering around Kisumu district as the major core and Uasin Gishu and Kericho as sub-cores. Figure 8.1 shows the most frequent movement between districts for each district. Trips in Trans Nzoia and Bungoma tend to center on Uasin Gishu and trips in Nakuru on Kericho. Kisumu attracts trips from all other districts including Uasin Gishu and Kericho.

Of all the people's trips by rail generated in the Region, about 75% are found their destinations outside the Region, while 12% of road trips move out of the Region.

The number of vehicle trips on roads is the largest for cars, followed by matatu and buses (Table 8.4). In number of passengers transported, however, matatu and buses share about 40% of all the passengers, respectively.

8.1.2 Commodity movement

Movements of major commodities in the Region are as follows.

(1) Maize (Figure 8.2)

Most of the maize is transported from the Region to the other parts of Kenya by road and railway. Only 47 out of 463 thousand tons in total are transported within the Region. Generally railway is the major transport means of maize, and road and Lake transport are used as feeder transport for railway. For example, in Kisumu, maize transported by road and Lake is transferred to railway. For medium distance transport to Nakuru, road transport plays a major role and for long distance transport, railway is dominant.

(2) Wheat (Figure 8.3)

Wheat is produced in the northern part of the Region and 53 thousand tons are transported to the other parts of Kenya primarily by railway. Wheat consumed in Kisumu is mainly transported from the other parts of Kenya by railway and road.

(3) Coffee (Figure 8.4)

Major coffee transportation flow in the Region is the transit road transport from Uganda to the other parts of Kenya, accounting for 171 out of 216 thousand tons, of which 82 thousand tons are by road and 89 thousand tons by rail. Coffee produced in the Region is transported by railway to outer regions and the coffee consumed in Kisumu is transported by road.

(4) Tea (Figure 8.4)

Tea produced in the Region is transported mainly by road (111 thousand tons) to the other parts of Kenya, and partly by railway (22 thousand tons). Transit tea from Uganda is carried by road (46 thousand tons).

(5) Cement (Figure 8.6)

About 130 thousand tons of cement are produced in other parts of Kenya and transported by railway to the Region. Road and Lake transport is used for distribution in the Region.

(6) Refined sugar (Figure 8.7)

About 160 thousand tons of refined sugar produced in Bungoma, Kakamega, Kisumu and South Nyanza are transported by railway to the other parts of Kenya. For the transportation within the Region and for the feeder transport to railway, road transport is also used.

(7) Petroleum fuels and other petroleum products (Figure 8.8)

About 260 thousand tons of petroleum products are transported from the other parts of Kenya by both road and railway. For transit transport to Uganda, road transport is dominant, carrying 450 thousand tons.

8.1.3 Road transport

(1) Road classification

A road network in Kenya is composed of two groups of roads: "Classified roads" and "Special purpose roads" including rural access roads. The total length of classified roads in the area is 16,357.1 km, which consists of 839.1 km of class A, 704.2 km of class B, 3,056.6 km of class C, 4,296.3 km of class D, and 7,460.9 km of class E roads. The total length of special purpose roads is 6,427.5 km, composed of 4,396.2 km of rural access roads and 2,031.3 km of others.

Functions of classified roads are as follow:

Class A - International Trunk Roads:
Roads linking centres of international importance and, crossing international boundaries or terminating at international ports.

Class B - National Trunk Roads:
Roads linking nationally important centres (principal towns/urban centres).

Class C - Primary Roads:
Roads linking provincially important centres to each other or to higher class roads (urban/rural centres).

Class D - Secondary Roads:
Roads linking locally important centres to each other, to a more important centre, or to higher class roads (rural/market centres).

Class E - Minor Roads:
Any road link to a minor centre (market/local centres).

Roads of the highest classes, A and B, have as their major function to provide mobility, while the function of class E roads is to provide access. The roads of classes C and D have, for all practical purposes to provide both mobility and access, with emphasis on mobility for primary roads and on access for secondary roads. These roads are generally the most difficult to design as far as traffic safety and operation are concerned. Figure 8. 9 shows all the A, B, and C roads in the Region.

Table 8.5 shows the surface condition by district and by road classification. In class A, all the roads in the area are bituminized, while about one third of all class A roads in Kenya are still gravel or earth. In other classes, ratios between bitumen and gravel and earth are roughly the same in the Region and Kenya. There are gravel and earth roads in class B in Kericho, Nakuru, Narok, Elgeyo-Marakwet and West Pokot districts. In class C, bituminized lengths are longer than gravel and earth only in Kisumu, Nakuru, and Nandi districts. Most roads are gravel and earth in Busia, Narok, Elgeyo-Marakwet and West Pokot districts.

(2) Traffic volume on road network (Figure 8.10)

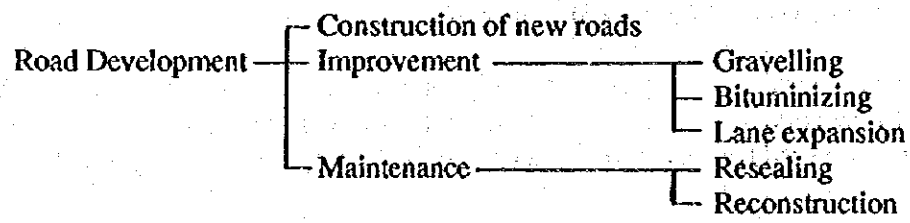
The only available traffic survey is called '60 points census' undertaken in 1985 by MOTC. According to the survey, traffic volumes on selected roads in the Region are as shown in Figure 8.10. Observed traffics in vehicles per day in the Region are summarized below.

Road	Position	Traffics (vehicles/day)
A 104	South of Eldoret	1,129
A1	South of Webuye	476
A1	17km North of Kisii	790
B1	North-west of Ambira	431
B3	South-East of Sotik	242
C14	6km East of Gorgor	23
C19	8km East of Kendu Bay	88
C26	3km from Oyugis towards Kendu Bay	252
C32	2km South of Kimaeti	26
C37	3km West of Nandi Hills	407
C42	North East of Malakisi	247
D248	6km from junction with D247 towards Kagilo	12
D257	4km from Amukura towards Myanga	13

Over 400 vehicles pass the points on trunk roads except for a point near Sotik. On primary roads, at some points, 200 to 400 vehicles are observed, and fewer than 100 vehicles at other points. On secondary roads, only about 10 vehicles pass at any point. All of these roads having two way traffics can accommodate about 1,500 - 2,000 vehicles/day as designed, if vehicles are all passenger-cars. Thus these roads are utilized fairly below their design capacities.

(3) Current issues

The development of road network consists of the following.



The present network conditions in the Region requiring development are outlined below.

Construction of new roads

The on-going Rural Access Road Program aims at constructing low cost roads in rural areas as a basic need, where the absence of a linkage to any market center prevents the areas from being developed. The program has been supported by foreign donors, and generally successful.

Gravelling

Gravelling makes a road passable in rainy seasons, assuring linkage to a market center. In principle, all the classified roads should be gravelled. From a viewpoint of equity between districts, Siaya and Trans Nzoia which have more earth roads than other districts need more attention. Priorities among earth roads to be gravelled should be determined based on potential contribution of each road to economic activities.

Bituminizing

MOTC informally sets 300 ADT (Average Daily Traffic) vehicles as a criterion for bituminization based on a cost benefit analysis and the internal rate of return exceeding current loan interests. Thus those roads having the traffic of more than 300 vehicles/day should in principle be bituminized.

Four-lane widening

Parts of the trunk road A104 may need to be widened to four-lane road in the future. The implementation timing should be determined by more detailed analysis of future traffic growth, reflecting the development of areas along the road.

Maintenance

It seems to be a consensus among those related to road development that rural road development and proper maintenance are of utmost importance at present. Maintenance, however, is not necessarily a most cost-effective way to improve traffic conditions. In some cases of high and heavy traffic roads, maintenance costs are actually higher than costs of reconstruction. The situation of some parts of A104 in the Region seems to be this case. Although more detailed cost comparison would be necessary, a decision was already made to reconstruct a portion from Malaba to Webuye with EEC's finance.

8.1.4 Railway transport

(1) Operating conditions

Railway network

A railway system in Kenya is being operated and maintained by Kenya Railway Corporation (KRC). The railway network in the Region forms a tree shape, consisting of the western part of Mombasa to Malaba line as a trunk line, Nakuru West - Kisumu line, and Kitale and Yala-Butere branch lines. There are over 60 stations in the Region every 10 km or so. The network in the Region is illustrated in Figure 8.A.1 of Attachment (A).

Operating services

Regular operation for passengers and goods by these lines are summarized below together with the travel time on each line.

Line		Frequency Up	Frequency Down	Travel time (hours)
Mombasa to Malaba				
Mombasa-Nairobi	P	2	2	15.0
	G	10	10	17.0
Nairobi-Nakuru-Eldoret	P	1	1	13.0
	G	12	10	15.0
Eldoret-Malaba	P	1	1	4.5
	G	5	4	4.5
Nakuru West to Kisumu	P	2	2	7.5
	G	4	4	8.5
Kitale Branch	P	-	-	-
	G	3	3	4.0
Yala-Butere Branch	P	1	1	3.0
	G	-	-	-

Note: P passengers
G Goods
Source: Kenya Railways

(2) Traffic demand

The utilization of the railway lines in the Region may be seen from data for the following seven stations: viz. Nakuru, Eldoret, Bungoma, Malaba, Kisumu, Butere, and Kitale.

Passengers

As is shown in Figure 8.11, the total number of passengers dealt at Kisumu station was about 500 thousand per year in recent years, which was much higher than those at any other stations dealing 20-150 thousand passengers.

Goods

The volume of goods is less variable among stations as seen from Figure 8.11, implying that production centers are distributed evenly among the areas surrounding these stations.

Nakuru station dealt 402,000 tons in 1985 (1,101 tons/day on average), while 95,000 tons were dealt at Kitale station (260 tons/day). At Butere station, regular service is not available for goods transportation.

The movements of goods of all kinds are summarized in Table 8.6. A large proportion of goods are transported to or from stations in the outer areas. The volume imported from the outer areas 831,000 tons/year is about twice as much as the export of 438,000 tons/year.

(3) Current issues

Current issues related to the railway transportation are discussed below in the following aspects:

- Capacity and future demand,
- Requests from companies to provide new facilities, and
- New line development.

Capacity and future demand

According to "the National Transport Plan", a proportion of present frequency of both goods and passenger trains to the maximum frequency which the present facilities could accommodate is as follows for each line in the Region.

Main Lines	Nakuru-Eldoret	93%
	Eldoret-Malaba	70%
Principal Lines	Kisumu-Nakuru	90%
Branch Lines	Kitale B.L.	40%
	Butere B.L.	20%

These figures indicate that there exists sufficient capacity. The possibility of the capacity being exceeded depends on the future growth of goods and passenger traffics, and the mixture of goods and passenger trains.

New line development

Two kinds of new line development have been discussed for years. One is Butere-Bungoma line and the other is Kedowa on Kisumu principal line - Kericho-Sotik-Kisii-Homa Bay line.

Expected function of Butere-Bungoma has changed from the by-pass of congested main line in steam-locomotive days to assisting Mumias sugar factory. It may also be important for transporting products along the Kisumu principal line contributing to the development of Kisumu as an export/import center to the neighbouring foreign countries.

Kedowa-Kericho-Sotik-Kisii-Homa Bay line running in the southern part of the Region aims at collecting tea at Kericho, passion juice at Sotik and sugar at Kisii, and conveying them to outer areas through Kisumu principal line or the Lake. It also gives more reliable transportation service for goods and passengers in this area.

Feasibility of these lines depends on how much cost reduction will be realized compared to road transportation. A preliminary discussion is given in Attachment (A) to this chapter.

8.1.5 Inland waterway transport

At present, KRC is operating the service for passengers and goods on Lake Victoria. The Lake also plays a role of connecting fishermen's homes, their working places and markets of their products.

(1) Operating conditions by KRC

Service routes

Lake ports which receive KRC's transportation service are Kisumu pier, Kendu Bay, Kowuor Pier, Homa Bay, Asembo Bay, Mbita (on Rusinga island), Sena (on Mfangano island). There are following two operation routes.

-- Kisumu pier - Kendu Bay - Kowuor Pier - Homa Bay - Asembo Bay
-- Kisumu Pier - Kowuor Pier - Homa Bay - Mbita - Mfangano

In Kisumu - Asembo route, the operation is one time each for up and down almost everyday. In Kisumu-Mfangano route, between Homa Bay and Mfangano, the fleet Kamongo calls only twice a week for both up and down.

Fleets in operation

The transportation service in the Lake is provided by the following mix
- 3 passenger boats
- 2 tugboats (M.T. Homa, S.T. Kavirondo)
- 9 lighters

The tugboats and lighters provide service for goods transportation upon request.

(2) Traffic demand

Passengers

The number of passengers continued to increase until 1981, but since then slightly decreased as shown below.

Year	1978	1979	1980	1981	1982	1983
Number of passengers	124,814	139,889	167,848	177,729	139,602	145,748

Cargo

(i) Cargo movements

Cargo volume shipped and received at Kisumu port had fallen in two stages: first due to the split of East African Community and secondly from the road network improvements such as

the completion of the trunk road between Kisumu and Kisii in 1979. There is a sign of recovery now as mentioned below.

(ii) Kinds of cargo

Cement and general goods are the major cargos transported from Kisumu pier to other ports. Cement once covered about 80% of the total cargo, but decreased to 23% in 1983, surpassed by general goods. Dried fish, maize and general goods constitute the major cargos from piers on the Lake to Kisumu pier.

The cargo recovery in 1983 is attributable primarily to the increase in shipments of maize, dried fish and general goods, more than compensating the decrease of cement shipment (see Tables 8.7 and 8.8).

(iii) Cargo shipping ports

Cargo from/to Kisumu pier are summarized in Tables 8.9 and 8.10 by kind of goods and by Lake ports. Only Kendu Bay and Homa Bay are receiving goods from Kisumu, such as consumer goods, cement and timber. Dry fish and maize are main goods to Kisumu. Homa Bay accounts for over 50% of shipments to/from Kisumu pier.

(3) Current issues

The advantage of waterway transport lies generally on massive transportation leading to low costs and thus stable and low prices of goods. Winam Gulf has much potential for transportation as it provides alternative routes to connect market centers around the Gulf.

Efficient transportation by waterway

The following possibilities are suggested at present to make more efficient use of waterways.

- Introduction of fast passenger boats
- Utilization of wagon ferries now anchoring
- Port development to accommodate ferries

The introduction of faster ships will attract more traffic leading to more cost savings. Also faster ships will allow more frequent operation, especially to the distant areas such as Karungu or Mfangano. Other two possibilities combined aim at further cost reduction due to scale economy of mass transportation. Now that C20 route from Rongo to Homa Bay has been bituminized, the potential has increased for Homa Bay to become another important distribution center.

Waterways for fishery

Collecting services along the shore and transporting to more profitable ports will surely be of help to fishermen. Otherwise fishes being dried are only consumed locally mainly for self-sufficiency. The issue should be further discussed, referring to specific fishing ports in the Region (Chapter 3, Sector Report).

8.1.6 Airway transport

(1) Airport

There is one airport and many airstrips in the Lake Basin region. Kisumu airport has the facilities for Fokker Friendship (F27) class aircraft and controlled by the Government (MOTC). Between Kisumu and Nairobi, Kenya Airways (KQ) operates nine scheduled flights per week, and few chartered flights are operated by other private companies. Other than Kisumu airport there are approximately 20 airstrips in the Region (Figure 8.12) and their operation is not controlled by the Government. To these airstrips, chartered flights are operated mainly from Wilson airport (Nairobi), Moi airport (Mombasa) and Malindi airport using small aircrafts. These airstrips have no facilities for passengers such as terminal building or telephones. Only for Eldoret and Masai Mara, scheduled services are offered.

(2) Traffic demand

Kisumu airport

Kenya Airways operates scheduled flight between Nairobi and Kisumu. There are no scheduled air link to other regional centers nor international destinations. Besides scheduled flights there are frequent arrivals and departures of charter and private light aircrafts. Kenya Airways started scheduled operation between Nairobi and Kisumu in 1982 using F27 with 2 flights per week and replaced the charter service that had been operated by Sunbird Aviation Limited. Kenya Airways increased the number of flights steadily, and as of 1986 nine flights per week were operated. (Table 8.11). Induced by increased frequency of service and low level of fare (Table 8.12), the number of passengers have grown rapidly (Table 8.13). Load factors of this line was always above 60% (Table 8.14), despite rapid increase in transport capacity.

According to the passenger survey in 1985 reported in "Kisumu Airport Development Feasibility Study, 1986" the largest group of passengers were on business travel connected with the private sector (36%). People returning to their homes or visiting relatives were the second largest users (31%), followed by government business (15%) and holiday or leisure travel. About 60% of the passengers were Kenyans.

Business - private sector	36%
Visiting friend / relatives	23%
Government business	15%
Holiday/leisure travel	12%
Residents returning home	9%

Nairobi and Kisumu were the final destinations for more than 70% of the passengers. For those passengers travelling onward from Kisumu or Nairobi, the main mode of transport was private vehicles (77%) and hire cars (16%). A small number of business travellers were connecting with private light aircrafts (7%).

Other airstrips

The demands for flights by charter companies to airstrips in Masai Mara National Reserve are based upon international tourism. Other airstrips such as Kitale, Eldoret, Kericho and Bungoma are mainly utilized by domestic tourists for business purposes.

(3) Current issues

Improvement of Kisumu airport is going on, with the installation of airfield lighting and ILS (Instrumental Landing System) facilities such as VOR (Very High Frequency Omnidirectional Radio Range) and DME(Distance-Measuring Equipment). The facilities such as apron and passenger terminal at Kisumu airport are not sufficient for medium size jet plane (DC9 class), and this hinders efficient transportation using jet planes, and raises operating cost of Kenya Airways.

Other airstrips require surface bituminizing or resealing. For some airstrips such as Mara Serena and Eldoret, facilities for scheduled flights such as passenger terminal and telecommunication facilities might be necessary in the near future.

8.2 Forecasts on Future Traffics

8.2.1 Framework for the traffic forecast

(1) Traffic network

Future traffics have been forecasted for the transportation network of the Region consisting of the following. First, of all the existing roads, the following have been taken into account.

1) Roads
   - Trunk roads (classes A and B)
   - Primary roads (class C)
   - Minor roads (classes D and E, and rural access roads)

2) Railways
   - Main line (Malaba - Nakuru)
   - Principal line (Kisumu-Nakuru)
   - Branch lines (Kisumu-Butere; Eldoret-Kitale)

3) Waterways
   - Kisumu-other ports

4) Airways
   - Kisumu-Nairobi

In addition, possible traffics on new routes have been considered to an extent. That is, districts were taken as basic units of analysis, and inter-district traffics are analyzed based

on the growth by district, and optimal allocation of the inter-district traffics to alternative routes was determined.

(2) Method of forecast

The following steps have been taken for the traffic forecast. First, traffic volume was projected by mode of transportation and by segment of each mode, assuming all the areas in the Region will grow equally. Second, the total projected volume on each segment was broken down by origin-destination, assuming the present patterns of traffic flow will not change in the future. The results of OD survey conducted in 1983 for the whole of Kenya was used for road traffics. For other modes of traffics each terminal or station was taken as origin/destination.

However, different areas in the Region will not grow equally so that the patterns of traffic flow will necessarily change. Thus as the third step, the results obtained by the steps outlined above were adjusted to reflect the difference in growth of population and economy among different areas in the Region as specified by the macro-frame (Section 3.3, Master Plan Report). That is, additional OD volume over the projected average was allocated in proportion to the population and economic activities of the origin/destination areas.

In this way, the future traffics with origin-destination have been obtained for each segment of the network in line with the macro-framework of the Master Plan. Technical details of the procedure outlined above are found in the Attachment (B) to this chapter.

8.2.2 Forecast of future traffics

(1) Total traffics

The total passenger traffic is projected, assuming it will grow following the population growth. By applying the 3.7% per annum growth of population set by the Master Plan, the total passenger traffic will increase by 2005 to 2.06 times the volume in 1985. The total freight traffic is projected, assuming it will grow following the increases in agricultural and manufacturing production. By applying the average annual growth rates of 5.0% and 7.6% respectively for agriculture and manufacturing set by the Master Plan, and assuming the current mixture of freight will not change, i.e. 78% of agricultural freight and 22% of manufacturing freight, the total freight has been estimated to increase by 2005 to 3.01 times the volume in 1985.

(2) Traffic increase by mode

Railways

Freight and passengers on railways have been projected based on the growth of agricultural and manufacturing products and of population, respectively. It has been derived from the traffic data in recent years that as the total volume of agricultural and manufacturing products or population grows by a unit per cent, the freight or the number of passengers grows by 0.63% or 1.16%, respectively. By applying these elasticity figures and the growth rates of